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The Journal of Bone and Joint Surgery

FIXED PARALYTIC OBLIQUITY OF THE PELVIS*

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This subject is so simple in its essentials that I hesitate to present it. Possibly it is for this reason that the literature has no references to it, for other surgeons may have felt the same diffidence that I now feel; and yet, simple though the essentials are, the analysis of some cases may be so difficult as to defy even the most experienced. Certain it is that the deformity, though outspoken, is frequently overlooked; or if recognized, no attempt is made to correct it.

If one leg is shorter than the other, and the patient stands, the pelvis is in an oblique position. This obliquity, however, is not fixed, and when the patient lies down it is easy to bring the anterior superior spines into a line which lies perpendicular to the mid-line of the body. With such an obliquity of the pelvis this paper is not concerned. Assume, however, that in a patient whose two legs are of equal length, the adductors of one side become paralyzed. The abductors, unopposed by the adductors, draw the leg into an abducted position in which it tends to become fixed. To bring the foot to the ground the patient must, perforce, tilt down the pelvis on the side of the abduction contracture, and this necessitates an upward tilt of the opposite side of the pelvis. These facts are illustrated diagrammatically in Figures 1, 2, and 3. In a pelvis of this kind the obliquity becomes fixed. That is, even in the recumbent position it is impossible when the legs are parallel to the mid-line of the body to bring the anterior superior spines into a line perpendicular to this. In such an individual, even though the legs are actually of the same length, an apparent lengthening of two to four inches may be present, caused by the obliquity of the pelvis. It is impossible for such an individual to bring his heels together when the knees

*Presented at the Annual Meeting of the American Orthopaedic Association, Chatham, Massachusetts, June 21, 1930.

FIG. 1

Diagram to illustrate the relation of the femora to the pelvis in an individual whose abductors and adductors are evenly balanced.

FIG. 2

Diagram to illustrate the relation of the femora to the pelvis in an individual whose adductors are paralyzed. The unopposed abductors draw the leg outward, and an abduction contracture ensues.

FIG. 3

Diagram to illustrate the final step in the development of a fixed pelvic obliquity in an individual whose adductor paralysis has resulted in an abduction contracture. To bring the abducted leg into a vertical position, the pelvis must be tilted downward on that side, thus causing an apparent lengthening of the leg.

are held extended. His gait is bound to be awkward because of the apparent difference in the length of his limbs, which, though only apparent, is intensely real to the patient.

It was in a woman of thirty-five who had had this inequality in the length of her legs since childhood that I first had an opportunity to study fixed pelvic obliquity and to work out an operative method for its correction[1]. Since then I have been able to observe a sufficient number of cases to evolve a simple classification and appropriate methods of treatment for the different types. First, however, the obvious fact must be emphasized, that a fixed obliquity of the pelvis is not necessarily disadvantageous. It is only when the legs are equal in length, or when the long leg corresponds to the low side of the pelvis, that disability results. If the short leg is on the low side, the pelvic obliquity helps to equalize the length of the legs and is therefore advantageous. This fact is of significance in evaluating the possible benefit to be derived from the Dickson operation. Since this operation frequently results in a moderate abduction contracture, its value is enhanced by a short leg on the operated side or, conversely, diminished if the leg is long. A word must also be said to clarify a possible confusion between the type of deformity being considered and that caused by a flexion contracture of the hip. A pure flexion contracture does not cause pelvic obliquity. When associated, as it so frequently is, with an abduction contracture, the pelvis is tilted down on the affected side. This tilt is, however, due entirely to the shortened abductors, and must not be charged to the account of the shortened flexors.

This brings us now to a consideration of the different types of paralysis which will cause fixed pelvic obliquity. I have been able to distinguish five groups:

1. Obliquity caused by contracture of the abductors. This includes not only the muscles but also the fascia and, in severe cases, the capsule of the hip joint. It causes apparent lengthening of the leg.
2. Obliquity caused by shortening of the adductors. This type is frequently associated with a subluxation or a paralytic dislocation of the hip. It causes an apparent shortening of the leg, which is of course magnified by an actual shortening if dislocation has occurred.
3. Obliquity caused by a combination of Groups 1 and 2.
4. Obliquity caused by contracture of the spinal and abdominal muscles and ligaments.
5. Obliquity caused by combinations of Groups 1, 2, or 3 with Group 4.

GROUP 1

CONTRACTURE OF ABDUCTORS

Mrs. G., age thirty-five, contracted poliomyelitis as a child of five. Ever since she could remember, her right leg has been much longer than her left. This has caused a peculiar gait and a pelvic deformity which discouraged her from having children.

The examination showed an apparent lengthening of the right leg of three inches, due to a corresponding downward tilt of the right side of the pelvis (Fig. 4-A). It was impossible for the patient to touch the right heel with the left unless she flexed the right knee. With the patient recumbent, and the anterior superior spines horizontal, the right leg showed an abduction contracture of thirty-five degrees. The actual length of the right leg was three-quarters of an inch less than the left, but the pelvic obliquity was so marked as to mask this completely. The lumbar spine had a convexity to the right (due to the pelvic tilt), but this curve could be obliterated by swinging the right leg into marked abduction. All the muscles had regained power except the right quadriceps and the adductors of the right thigh. These were completely paralyzed. In devising an operative correction, due attention had to be given not only to overcoming the contracture, but to the prevention of its return. A sixteen-inch incision was made along the outer aspect of the right thigh

FIG. 4-A

Outline drawing of Case 1, to show the fixed pelvic obliquity and the apparent lengthening of the right leg due to the abduction contracture resulting from paralysis of the adductors.

FIG. 4-B

Outline drawing of Case 1, to show the effect of operative treatment of the abduction contracture. The fixed pelvic obliquity and the apparent lengthening have been corrected.

extending from two inches above the trochanter down to the knee. The fascia lata was exposed by dissecting back the skin. It was divided transversely two inches below the trochanter together with the anterior fibers of the gluteus maximus (Fig. 5). This fasciotomy permitted about ten degrees correction of the abduction contracture. Next the tip of the trochanter, together with the insertions of the gluteus medius and minimus, was chiseled away (Fig. 6). This gained another ten degrees. Some contracture, however persisted; enough to prevent apposition of the heels. Therefore, the trochanter tip was retracted upward to expose the capsule of the hip joint (Fig. 7). This was found taut as a bow-string. As it was cut transversely, a snapping sound was heard and the leg could easily be swung into adduction. So much for the correction of the contracture. To prevent its recurrence a strip of fascia lata of the distal half of the thigh, measuring nine inches long and two inches wide, was freed by two lateral incisions and a short transverse incision just above the knee (Fig. 7). The fascial strip was left attached above, at a point seven inches below the trochanter.

FIG. 5

Photograph of cardboard model illustrating: (1) transverse incision through the fascia lata which was the first step in relieving the abduction contracture (Case 1); (2) the fascial flap, transplanted in the final step of the operation.

FIG. 6

Photograph of cardboard model illustrating the second step of the operation for relief of abduction contracture (Case 1). The gluteus maximus has been retracted, exposing the tip of the trochanter which is chiseled away, carrying with it the insertions of the gluteus medius and minimus.

The free lower end was then brought obliquely upward and inward through a subcutaneous channel to the pubic spine (Fig. 8). It formed an angle of about forty-five degrees with the vertical axis of the thigh. To prevent a tear of its pedicle, several chromic stitches were taken to reenforce the fascial hinge. Then the leg was adducted fifteen degrees and the fascial strip sutured under a few pounds' tension to the pubic spine. No attempt was made to suture the trochanter back into position since this was obviously impossible with the leg adducted. The leg was immobilized in a plaster spica for six weeks.

The result of the operation (performed eight years ago) has been a permanent correction of the pelvic obliquity and the associated inequality in the length of the legs. The patient walks with a very slight limp due to the quadriceps paralysis. She is able to adduct the thigh actively, probably through the action of the psoas iliacus and to abduct it, thus

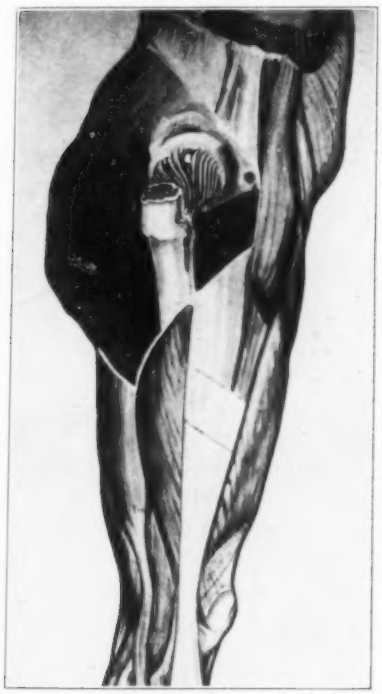

FIG. 7

Photograph of cardboard model illustrating the third step in the correction of a severe abduction contracture (Case 1). The tip of the trochanter, together with the gluteus medius and minimus, has been retracted upward, exposing the capsule of the hip joint. The capsule is incised transversely for a sufficient distance to permit the thigh to be freely adducted.

FIG. 8

Photograph of cardboard model to illustrate the fascial transplant used to prevent recurrence of the abduction contracture (Case 1). The fascial strip, measuring about 8 inches long by 2 inches wide, is brought subcutaneously upward and inward to the spine of the pubis, where it is fastened with sufficient tension to hold the thigh adducted 15 degrees.

FIG. 9

Case 2 before operation. There is a fixed pelvic obliquity and an apparent lengthening of the left leg of three inches, due to the abduction contracture.

FIG. 10

Roentgenogram of Case 2 before operation. Note the pelvic obliquity, the abduction of the left thigh, and its external rotation.

FIG. 11

Roentgenogram of Case 2 after operation. The pelvic obliquity has been reduced from a three-inch tilt to one-half inch. The external rotation and abduction of the thigh has been completely corrected.

indicating that the gluteus medius and minimus regained an attachment to the femur despite the upward displacement of the tip of the trochanter during the operation.

A second case in this same group is worthy of report since it indicates the great importance of the gluteus maximus. Mary S., aged eleven, had poliomyelitis at three years of age. Patient was unable to walk despite a well fitted brace, because of two and one-half inches difference in the length of the legs. This was due to a downward tilt of the left side of the pelvis, causing an apparent lengthening of the left leg of two and one-half inches. The tilt was due to a contracture of the abductors of the left hip (Fig. 9). A peculiar feature was the external rotation contracture of the left thigh. At the operation, the same general plan was followed as in Case 1, but it was evident after the primary transverse division of the fascia lata, that the

external rotation contracture was caused by a shortening of the gluteus maximus fibers. To expose these, the incision had to be prolonged backward. Only after the gluteus maximus had been freely divided was it possible to rotate the thigh internally. Figure 10 shows the pelvic x-ray picture before the operation; Figure 11 three months later. Figure 12 shows the patient six months after the operation. The pelvic obliquity has been corrected and she is able to walk with the aid of one brace and one crutch.

GROUPS 2 AND 3

I shall consider these two groups together, since contraction of the adductors is usually associated with that of the abductors.

Frieda K., aged eight, had a paralysis due to spina bifida. In addition to severe club-foot deformity this patient had a fixed pelvic obliquity due to abduction contracture of the right side, adduction contracture of the left

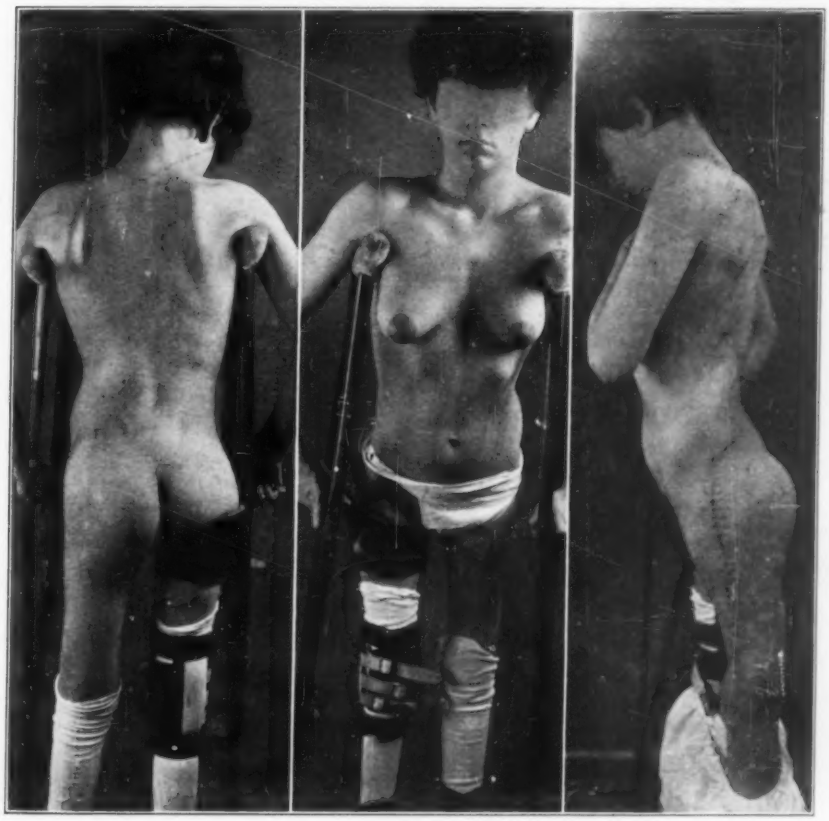

FIG. 12

Photographs of Case 2 after operation. The pelvic obliquity has been corrected and the legs are of equal length.

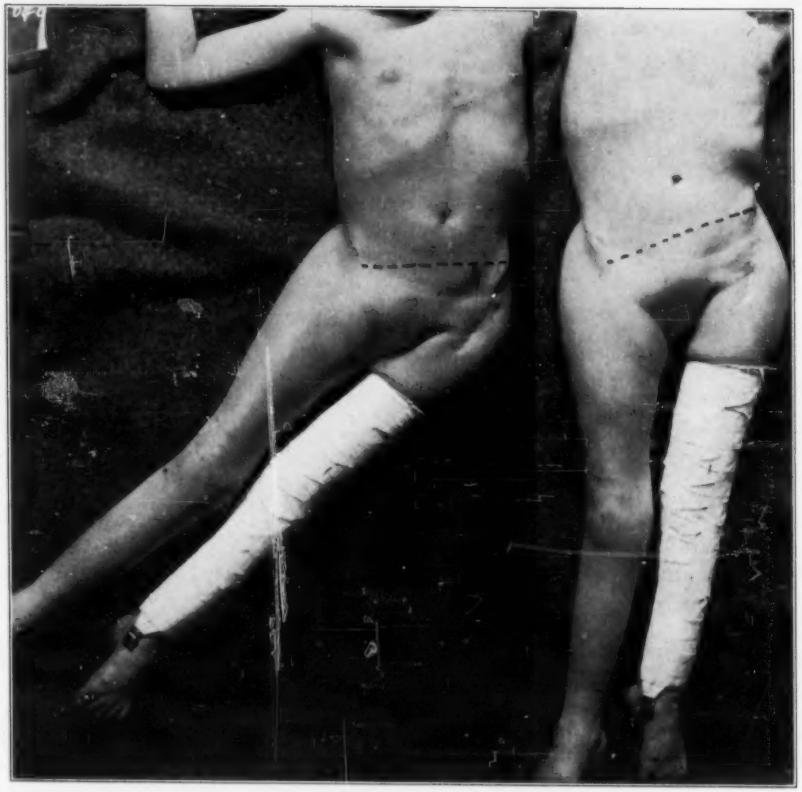

FIG. 13

Photographs of Case 3 before operation. When the pelvis is squared the right leg is abducted 35 degrees, the left leg adducted 35 degrees. The legs can be brought parallel to the vertical axis of the body only by tilting the left side of the pelvis upward 3 inches.

FIG. 14

Photographs of Case 3, standing, before operation. To the apparent shortening of the left leg, due to contracture of the right abductors and of the left adductors, is added the actual shortening due to a dislocation of the hip.

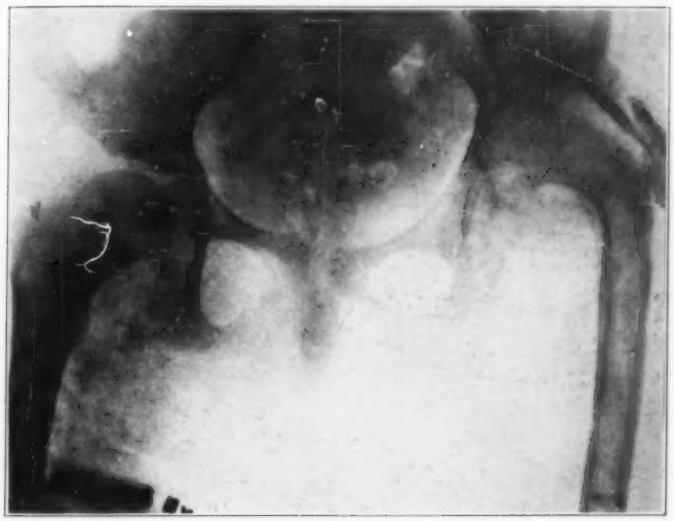

FIG. 15

Roentgenogram of Case 3 after correction of the abduction and adduction contractures, reduction of the dislocation, and fusion of the left hip.

(Fig. 13). The shortening of the left leg produced by the pelvic obliquity was enhanced by a complete upward dislocation of the femur. The total shortening amounted to almost four inches. The child had never been able to walk (Fig. 13).

The treatment consisted of the following operations:—

(1) Division of the abductors of the right hip.
(2) Division of the adductors of the left hip.
(3) Open reduction of dislocation of left hip.

The operations in themselves do not merit comment, except that by combining the three procedures the fixed pelvic obliquity was overcome so long as the patient remained recumbent. Unfortunately, however, since no strength returned to the abductors of the left hip, when the patient was allowed to stand, the left thigh at once adducted, threatening a recurrence both of the dislocation and of the pelvic obliquity. Had the patient had a good tensor fasciae, a Dickson operation would have been indicated. Since her tensor was very weak, there was only one procedure which I could think of to ensure stability—namely, a fusion of the hip (Fig. 15). This gave the patient adequate stability (Fig. 16) and enabled her to walk with the aid of braces and crutches.

GROUP 4

OBLIQUITY DUE TO CONTRACTURE OF SPINAL MUSCLES

Many cases of paralytic scoliosis are not complicated by obliquity of the pelvis. Despite a marked curve or tilt of the body the pelvis remains

FIG. 16

Photographs of Case 3 after operative correction of the pelvic obliquity.

horizontal, and the length of the legs equal. What causes the marked tilt in some cases is still a matter of conjecture. I believe it is due to a paralysis of the spinal and abdominal muscles of one side, with retention of power on the other side. If, in addition, the quadratus lumborum is also paralyzed on the one side but active on the other, a downward tilt of the paralyzed side would seem to be inevitable.

Israel K., aged fourteen, had infantile paralysis as an infant. The patient was barely able to walk, owing to the difference of four inches in the length of the legs, although his muscle chart showed more than fair strength in most of the leg muscles. On casual inspection, I thought he surely had an abduction contracture of the right thigh for the right side of the pelvis was tilted downward just as in the cases of the first group (Fig. 17). Test of the pelvitrochanteric muscles, however, showed this view to be erroneous. Nor was there any contracture of the adductors of the left side. The pelvic tilt was due entirely to a contracture of the spinal muscles and ligaments, the left side being pulled upward by the strong muscles, the right side tilting downward because of the paralysis of the corresponding group. The lumbar and lower dorsal spine was fixed in a rigid right convex curve (Fig. 17). Irrespective of the position of the leg this pelvic obliquity persisted and it therefore represented a higher degree of fixation of the obliquity than in the first three groups. Owing to the rigidity of the spinal curve, the problem was not easy. It took more than six months of effort to correct the tilt. The first attempts with traction were quite unsuccessful. Then followed one hinged jacket after another, until finally we were able to get a grip on the crest of the left ilium. Then correction was secured. In applying the plaster corsets I followed the technique of Dr. Hibbs' clinic, incorporating a hinge anteriorly and posteriorly at the apex of the curve and a turnbuckle on the concave side. Sufficient plaster was removed over

FIG. 17

Photographs of Case 4 before treatment. The fixed pelvic obliquity is due to a contracture of the left quadratus lumborum and of the corresponding spinal muscles, and to a paralysis of those of the right side. There is no abduction or adduction contracture.

FIG. 18

Photographs of Case 4 after treatment by a series of hinged plaster corsets and fusion of the spine.

the convexity to permit the body to be rotated on the two hinges as an axis. The thigh was included on the concave side. After the pelvic obliquity had been overcome, a fusion of the first, second, third, and fourth lumbar, ninth, tenth, eleventh, and twelfth dorsal vertebrae was done, and the back immobilized for three months in plaster. The result is shown in Figure 18. The pelvic obliquity has been corrected, and the legs are of equal length. A moderate right lumbodorsal scoliosis is still present.

GROUP 5

COMBINATION OF GROUPS 1, 2, OR 3, WITH GROUP 4

Hyman A., nine years old, had poliomyelitis one year ago. His was a most extensive paralysis, involving almost every muscle of the upper and lower extremities and of the trunk. Although a recent case, he had already developed a fixed pelvic obliquity (Figs. 19 and 20), resulting in an apparent lengthening of the right leg of two and one-half inches. This obliquity was due to three factors:

(1) A thirty-five-degree adduction contracture of the left thigh.
(2) A thirty-five-degree abduction contracture of the right thigh.
(3) A right convex dorsolumbar scoliosis.

It seemed to me probable that the contractures, because of their comparative recency, might yield to non-operative methods. The patient was accordingly immobilized in an apparatus designed to pull downward and outward on the adducted left leg, and push upward and inward on the

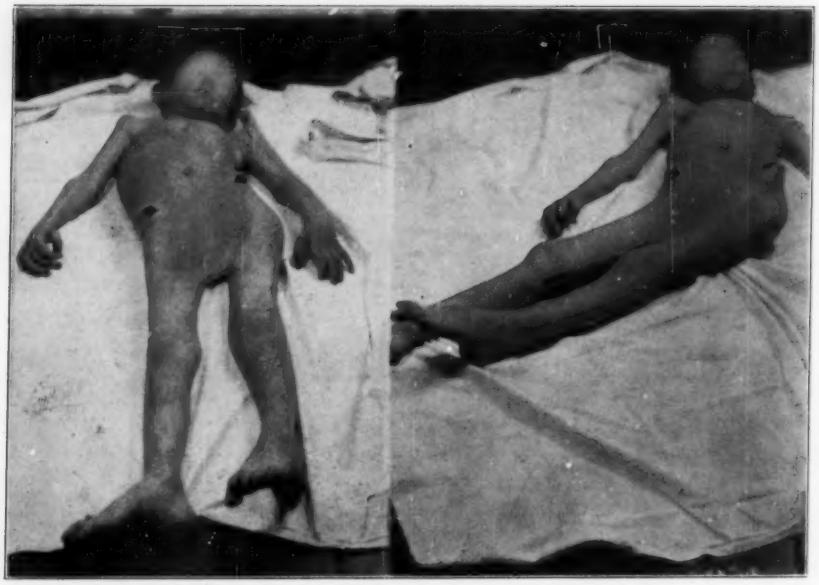

FIG. 19

Case 5 before treatment. The pelvic obliquity is due to three factors—(1) contracture of the right abductors, (2) contracture of the left adductors, (3) contracture of the left quadratus and spinal muscles.

abducted right leg. This device is pictured in Figures 21 and 22. For the upward push a box containing a strong spiral spring was placed between the bed and the right foot. Against this the patient was taught to thrust his right leg in such a way as to push the right side of the pelvis upward and at the same time adduct the leg. To prevent knock-knee and to facilitate the transmission of the force, a bivalved plaster-of-Paris splint was applied from the ankle to the hip. To overcome the scoliosis, the head of the bed was raised on ten-inch blocks and a Sayre suspension applied to the patient's head. After a week it was obvious that the abduction contracture was yielding but the adductors of the left hip remained taut. They were, therefore, divided. Correction of the deformity then proceeded without hindrance. The advantage of the method employed

FIG. 20

Roentgenogram of Case 5 to illustrate the degree of pelvic obliquity.

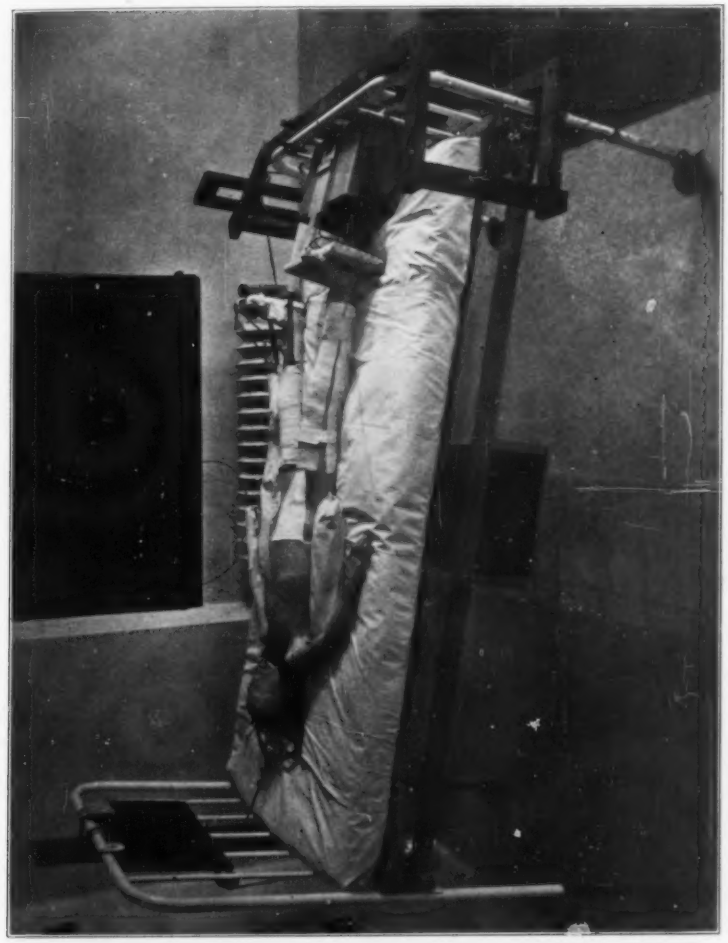

FIG. 22

FIG. 21

Photographs of Case 5, illustrating the push-and-pull apparatus used to correct the pelvic obliquity.

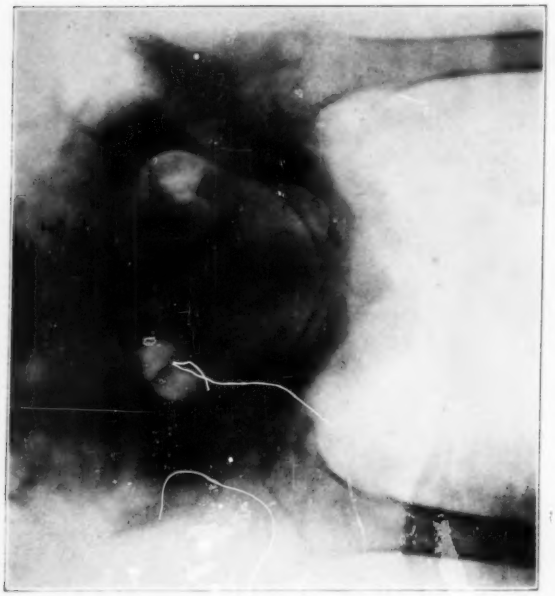

FIG. 24
Roentgenogram of Case 5 after correction.

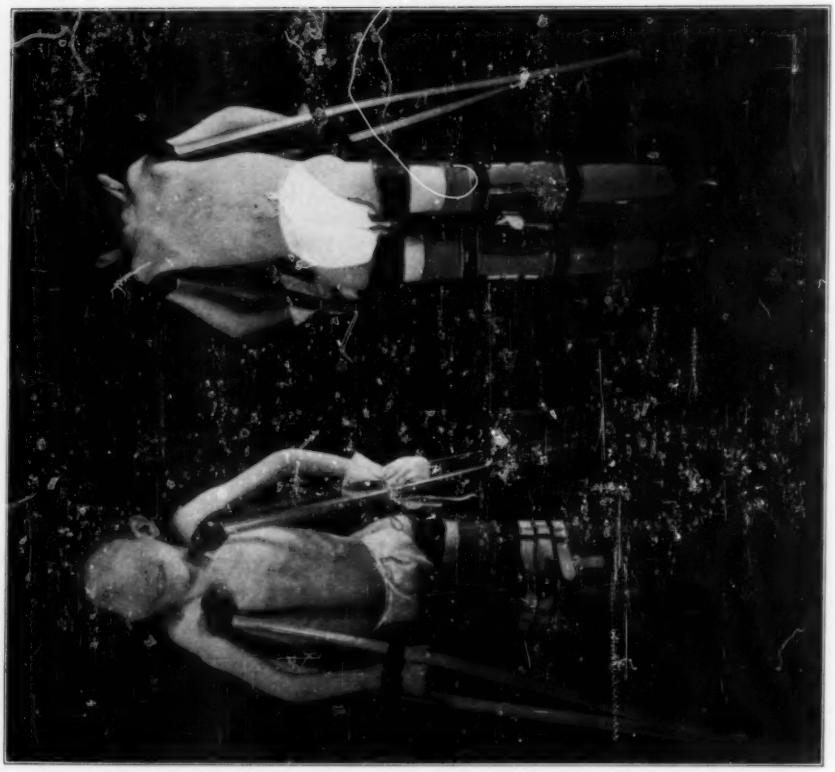

FIG. 23
Case 5 after correction.

was that the patient could be given corrective exercises, electrical stimulation of the weakened muscles, and massage without interfering with the correction of the pelvic obliquity. The significance of the spinal curve was appreciated fully when, after four months of bed treatment, the patient was allowed up with braces and crutches. Though the abduction and adduction contractures were completely corrected, the pelvis promptly sank on the right side, owing to the complete paralysis of the right abdominal and back muscles. He was therefore given an additional six months of recumbency on a corrective plaster shell, in the vain hope that the paralyzed back and abdominal muscles would recover. When this did not occur, the spine was fused in two stages from the sacrum to the fourth dorsal. Despite the extensive arm and leg paralysis, the patient is now able to walk and there has been no recurrence of the pelvic obliquity (Figs. 23 and 24).

SUMMARY

Fixed obliquity of the pelvis, as contrasted with obliquity due to actual shortening of a leg, is caused by a contracture either of the structures connecting pelvis and thigh, or pelvis and spine. It is characterized by the fact that, when both legs are held parallel to the mid-line of the body, it is impossible to square the pelvis, even when the patient is in the recumbent position. Its practical significance is due to the apparent difference in the length of the legs which it causes. Five types may be distinguished:

(1) Due to contracture of the abductors.
(2) Due to contracture of the adductors.
(3) Due to contracture of both abductors and adductors.
(4) Due to contracture of spinal and abdominal muscles, and of the quadratus lumborum.
(5) Combinations of Groups 1, 2, or 3, with Group 4.

The deformity can be corrected in the early cases by a push-and-pull apparatus; in the more advanced cases by suitable division of the contracted structures, coupled with stabilizing procedures to prevent recurrence of the deformity.

1. Mayer, L.: An Unusual Type of Paralytic Abduction Deformity of the Hip—An Operation for its Cure. Surg. Gynec. Obstet., XL, 421, 1925.

LOW BACK PAIN

A Study of 525 Cases of Sacro-iliac and Sacrolumbar Sprain*

BY LEO J. MILTNER, M.D., PEIPING, CHINA, AND CHESTER S. LOWENDORF, M.D.
IOWA CITY, IOWA

The subject of low back pain has a definite interest to almost every branch of medicine and surgery. It is a perplexing problem with which we are daily confronted. Systematic study is very necessary because of the unlimited possibilities of interpretation. For practical purposes, the classification of Steindler[1] seems most opportune. He divides the cases into two main types: first, those with symptomatic low back pain, wherein the distress is referred from pathology or underlying disease elsewhere; and second, the idiopathic low back pain, due to regional disturbance of the skeletal structures or their immediate surroundings.

Referred backache from the gastro-intestinal tract is not infrequent[2]. An overloaded colon may cause pain, not only by its weight, but also by causing referred pain along the upper two lumbar nerves. Uterine displacement may give referred sacral pain. Renal disturbances may cause pain to radiate along the twelfth dorsal nerve.

There is considerable difference of opinion among the various authorities about the relation between gynecologic pathology and backache. Graves[3] claims eighty-six per cent. relief from backache in a large series of cases operated on for retroversion at the Brookline Free Hospital. Plass[4], on the other hand, believes that low backache is rarely of pelvic origin, although he appreciates the fact that uncomplicated retroversion uncommonly, and pelvic infections and tumors, and fascial relaxations somewhat more frequently, do give rise to definite low back pain, which is relieved by correction of the condition. Cabot believes that there is no type of backache or reflex pain that can be definitely referred to pelvic disease. In this study we found that retroversion, in itself, has little, if any, relation to backache. Frequently, however, we found cases in which, after suspension of the uterus and repair of the markedly relaxed pelvic floor, the patients obtained considerable relief. In these instances, the correction of the pelvic ptosis, with automatic correction (in part, at least) of the associated enteroptosis, was considered the most important factor in giving relief.

Diseases and tumors of the meninges and cord are also to be remembered. Likewise, infections of the vertebral column,—such as chronic osteomyelitis, tuberculosis, typhoid spine, arthritis, and arthropathies—must be considered. With the addition of the x-ray to our armamentarium

*Read before Clinical Hospital Society of the State University of Iowa, March 1930, from the Department of Orthopaedic Surgery of the State University of Iowa,—Service of Dr. A. Steindler.

and the recent improvements in technique, it is relatively easy to discover and rule out most of the last mentioned conditions.

The exact mechanism by which more or less severe pain is felt in various parts of the body at a distance from the diseased organ is well explained by Starr[5]. The visceral nerves and general sympathetic nervous system communicate with the spinal cord at various levels throughout its entire length. Irritation, which is transmitted to the spinal cord through these nerves, sets up sensory impulses in various segments of the cord, each segment receiving impulses from a certain organ. These sensory impulses travel on up to the brain, where they become conscious perceptions. They are referred by consciousness, not to their point of origin, but to that part of the body from which sensations usually come when received at the particular segment irritated. Hence, the mechanism for the referred pains, such as pain in the forehead or back of the neck in eye strain; or pain down the left arm in heart disease; or pain under the right shoulder blade in disease of the liver; or the other pains felt in the lower back in affections of the abdominal or pelvic viscera. Pain produced by diseases of the spinal cord is due to an irritation or injury of the posterior nerve roots at their entrance, or to an irritation of the sensory tract passing upward through the spinal cord. In these instances the pain is not referred to the back, but to that part of the body from which the irritated sensory tract has come. So, in locomotor ataxia and syringomyelia, the pain is referred to the periphery corresponding to the segment of the cord involved.

In the consideration of the second great group, the low back pain of mechanical origin, or low back sprain, we must rule out the more severe injuries, especially fractures and fracture dislocations[1]. Most patients who have had any kind of an accident, even remote, and who later discover pain in the back, no matter where, invariably attribute the distress to the accident (or to some strain or blow). The incidence of these causal factors as taken from the history, when correlated with the general physical examination, will frequently reveal some symptom complex, which places the etiology in the "symptomatic group". Ridlon[6] believes that a large number of painful backs, for which one cannot account, are due to circulatory changes: changes that give loss of expansibility and contractility, and hence ischaemia of the musculature. This theory might well be applied to certain of the idiopathic group, wherein peripheral manifestations of circulatory troubles were evidenced.

In Table I can be seen the gross distribution in this clinic of cases in which the entrance complaint was low back pain.

From the analysis of the statistics here presented, the causes for low back pain in order of relative importance are: (1) arthritis (1350 cases); (2) sacro-iliac, sacrolumbar, and combined sprains (525 cases); (3) muscle strain (100 cases); (4) lumbar myositis (25 cases); and (5) other unusual conditions as spondylolisthesis, fractures of the transverse processes, fractures of the articular facets, undiagnosed fractures of the vertebral bodies, and Kümmell's kyphosis (50 cases).

TABLE I

ETIOLOGY OF LOW BACK PAIN

Etiology	*No. of Cases*
Osteo-arthritis	1050
Atrophic arthritis	300
Sacro-iliac sprain	326
Sacrolumbar sprain	114
Combined sacro-iliac and sacrolumbar sprain	85
Lumbar muscle strain	100
Lumbar myositis (myofasciitis)	25
Spondylolisthesis	22
Fracture of transverse process	14
Fracture of articular facet	7
Fracture of lumbar vertebrae (undiagnosed)	5
Kümmell's kyphosis	2
Total No. of Cases	2050

In this study of low back sprain, it is of particular interest to note that in the original diagnosis files there were 1375 cases listed as sacro-iliac, sacrolumbar, or combined sacro-iliac and sacrolumbar sprain. These cases have had careful follow-up records at intervals of a few months for a period of from one to ten years. In reviewing these 1375 records, it was found that 850 cases of this group had to be rediagnosed and replaced in the arthritic files because of the development of true arthritis of the lumbosacral region. This study indicates that the differential diagnosis between sprain and arthritis is very difficult in the first few weeks or months of symptoms and that frequently only by long periods of observation is one able to know the true nature of the pathology. Very frequently cases with negative x-rays at the first observation showed definite arthritis upon follow-up roentgenograms a year or two later; and the clinical findings were in accord with the pictures.

This study is concerned chiefly with low back pain due to sacro-iliac, sacrolumbar, or combined sacro-iliac and sacrolumbar sprain.

In the etiological studies (Table II), the cases of sprain are classified as traumatic, occupational, postural, and "others". Under "others" are included those cases that are due to: (1) abnormal weight distribution secondary to such causes as hip disease, a short leg, and other deformities; (2) mechanical instability of the foot (Goldthwait[7, 8]); (3) toxic states with acutely weakened musculature; (4) gynecological and obstetrical backache due to such causes as relaxed pelvic floor with retroversion, separation of the symphysis, pelvic inflammatory conditions, pregnancy, etc.; (5) obesity with pendulous abdomen; and (6) psychoneurosis.

Unusual attitudes or malposture may either cause or predispose to chronic sprain. Many a case of postural backache has been cured in the gymnasium by selected exercises for the weakened musculature. Especially do patients of the aesthenic type respond to exercises. As the rule, these individuals stand in the position of greatest possible muscular relaxation. The feet are pronated, the knees and hips hyperextended, the lumbar lordosis increased, the shoulders drooped, and the abdomen protruding; and there is the associated visceroptosis. These patients are actually held in

the erect position by their ligaments, the weakened musculature showing loss of tone with resultant impoverished blood supply[9]. Certain of the occupations demand extreme use of the lumbosacral region, and those cases giving a history of the onset of backache some short time after excessive stooping, bending, lifting, or twisting motions, are classed as occupational. This group might be termed as chronic traumatic in contradistinction to that greater group, the acute traumatic variety with immediate symptoms.

Steindler[1] lists four cardinal features upon which the diagnosis can be based, in either the sacro-iliac or the sacrolumbar case. First, there is a definite anatomic point of tenderness, which is circumscribed. Second, there is a typical position of aggravation of the pain. Third, there is a position of relief from painful symptoms. Fourth, acute sprains respond to immobilization of the joint in the position of relief, or in such position as will relax the sprained ligaments.

Localized tenderness upon pressure is usually found over the anatomical location of the posterior sacro-iliac ligaments in sacro-iliac sprain and over the posterior lumbosacral angle in lumbosacral sprain. In the sacro-iliac case[10], when the patient is seated, with the knees bent and the hamstrings relaxed, he can bend forward freely, but when standing he may show marked limitation of forward flexion owing to the tension of the hamstrings holding the pelvis fixed. A lumbosacral case will show no difference in spinal movement whether sitting or standing because he holds the lumbosacral region rigid, the forward flexion chiefly taking place in the hip joints.

These four features together with a careful history allow for a diagnosis of acute and uncomplicated sprains rather readily. In the combined double sacro-iliac, or the sacro-iliac and sacrolumbar sprain, or in those complicated by radiated pain, the picture must necessarily be altered. Especially in the chronic cases there is found difficulty in coming to a decision on the diagnosis. Sometimes the only findings in the mild persistent cases are those of pain on bending, stooping, or twisting, there being no definite point of localization of the pain, no definite tenderness on pressure, and only poor response to supportive measures. The fact that chronic cases are often not relieved by immobilization is usually due to faulty or incomplete rest of the parts. In certain instances, it is only by complete bed rest plus supportive measures that true rest can be afforded the sprained ligaments.

In studying this series, it was found that in well over fifty per cent. of the cases, symptoms persisted into the chronic stage. Especially in the postural and occupational groups were the symptoms found to continue over a period of years. Not infrequently this type of history was given: "Following the first pregnancy years ago, the patient developed pain in her lower back. The pain has persisted more or less ever since. It was aggravated by each succeeding pregnancy, aggravated by menstrual periods, and especially made more severe by heavy household duties. There was no acute pain. There was no discomfort at night while in bed, and there was no stiffness in the mornings." It was relieved completely by rest and supportive measures.

In those engaged in hard laboring occupations, there was, as the rule, a history of a mild wrench or sprain of the lower back,—not severe enough to make the patient stop work. Increasing discomfort in the lumbosacral region continuing over a long period of time, aggravated by work, relieved by rest, and without pain at night or morning stiffness, was the usual story. The response to supportive measures was very striking. Occasionally, however, long periods of rest, immobilization, and physiotherapy, or even changes in occupation were necessary to bring about the desired relief.

TABLE II

LOW BACK SPRAIN

(525 Cases Studied)

Etiology	*No. of Cases*	*Per cent.*
Traumatic	240	45.7
Occupational	73	13.9
Postural	107	20.3
Others	105	20.0

In those cases of sacro-iliac sprain or sacrolumbar sprain, in which symptoms persisted into the chronic stage (*i.e.*, for months or years), the differentiation from chronic arthritis becomes very difficult. Most observers believe that the majority of such cases are of arthritic nature. It was surprising to find that, of 1375 cases in which the first diagnosis was sacro-iliac or sacrolumbar sprain, after one to ten years' observation, 850 of this group had the diagnosis changed to lumbar arthritis. The new diagnosis was usually made either by follow-up x-rays or by the development of multiple arthritis. In certain instances the history alone was sufficient to reveal the true cause of the pain. The story of an almost constant dull ache present while in bed, or while resting, the stiffness of the lumbar and sacral region with increased pain in the morning upon waking, the comparative relief from this distress by change of position or by moving about, the limitation of motion in the lumbar and sacral spine, are all characteristic of an early arthritis. It is in this latter type of case that a neurosis is frequently laid down as a background for the complaints. In studying the records, it was found that a large number of patients branded as "neurotic" showed up later with typical arthritis. It is for this reason that one is often forced to hesitate a long time before he can become convinced that the condition is, or is not, functional. Herndon[11], in a series of 941 cases of back injuries in industrial employees, reports neurosis in one per cent. and malingering in four per cent. In this series of 525 cases, there were eight (1.5 per cent.) who had a definite psychoneurosis which was, according to the opinion of all observers, entirely responsible for the pain.

Certain symptoms (Table III),—such as the radiation of the pain, and the posture assumed, seemed to bear a definite relation to the type of sprain. The sacro-iliac cases, as the statistics show, were more apt to have sciatic radiation (64.1 per cent. as compared with the sacrolumbar cases 21.9 per cent.). Radiation into the areas of the lumbar nerves was present in seven

per cent. of the sacro-iliac cases and in three and four-tenths per cent. of the sacrolumbar sprains. Pain in the course of the superior gluteal nerve was present in six and one-tenth per cent. of the sacro-iliac and in two and six-tenths per cent. of the sacrolumbar cases. Even though these findings did bear a constant numerical value, the real worth of these symptoms in the differential diagnosis between sacro-iliac and sacrolumbar sprains is a matter of debate.

TABLE III

CASES STUDIED FOR RADIATION OF PAIN AND ASYMMETRICAL POSITIONS

Sacro-iliac sprain	326 Cases
Sacrolumbar sprain	114 "
Combined sacro-iliac and sacrolumbar sprain	85 "
Total No. of Cases	525

	Sacro-iliac Sprain		Sacrolumbar Sprain		Combined Sacro-iliac and Sacrolumbar Sprain	
	No. Cases	*Per cent.*	*No. Cases*	*Per cent.*	*No. Cases*	*Per cent.*
No radiation	75	22.6	82	71.9	36	42.3
Sciatic radiation	209	64.1	25	21.9	36	42.2
Lumbar radiation	23	7.0	4	3.4	6	7.0
Gluteal radiation	20	6.1	3	2.6	7	8.2
Total No. of Cases	326		114		85	

Concerning the posture assumed by the patient (Table IV), the unilateral sacro-iliac case frequently showed a contralateral tilt or position of relief (24 per cent.). A smaller percentage of unilateral sacro-iliac cases showed a list to the same side as the sprain (homolateral) (8 per cent.). In explanation of the contralateral list, the patient leans to the opposite side to relieve the strain on the affected joint. Homolateral list is usually seen where there is an associated sciatica on the same side as the pain, and it is suggested by Putti[20] that in these instances the sciatic pain is the most disturbing feature.

TABLE IV

STUDY OF ASYMMETRICAL POSITIONS

	Contralateral List	*Homolateral List*
Sacro-iliac sprain	24%	8%
Combined sacro-iliac and sacrolumbar	8%	8%

Special tests are of great value in the differential diagnosis and location of low back pain. Straight leg raising causes pain where there is sciatic radiation in either sacro-iliac or sacrolumbar sprain. Forcible compression of the iliac crests often elicits pain in the sprained sacro-iliac joint, but usually has no effect on the sacrolumbar sprain. Laguere's sign, which consists of forcing the leg in flexion, abduction, and outward rotation, causes pain in the affected sacro-iliac joint. As a rule, this manoeuver does not cause pain in a painful sacrolumbar area. Goldthwait's and Gaenslen's signs similarly produce pain in the affected sacro-iliac with slight effect upon the sacrolumbar articulations. In the former, the thigh is strongly

flexed with the knee extended. The tension of the hamstring muscles produces a rotatory force upon the painful sacro-iliac joint. In the latter, the thigh and the knee on the affected side are flexed so that the extremity is pressed against the chest; then upon hyperextension of the opposite hip, pain is felt in the affected sacro-iliac joint. It is often very difficult to fix the spine so as to relieve it of stress when exerting force upon the sacro-iliac joints, or to fix the sacro-iliac regions in a position of relief while placing stress upon the lumbosacral junction. This is especially so when the sprain is acute and has associated spastic limitation of motion (Wentworth[18]).

TABLE V

X-RAY STUDIES OF LUMBOSACRAL ANGLE IN SACRO-ILIAC AND SACROLUMBAR SPRAIN

144 Cases
(After Method of von Lackum[19])

	No. of X-rays Studied	*Greatest Angle (degrees)*	*Smallest Angle (degrees)*	*Average Angle (degrees)*
Male	79	135	95	119.0
Female	65	140	95	117.4

The radiographic findings (Tables V, VI, VII) are not of much value in the differential diagnosis between sacro-iliac and sacrolumbar sprain. Whatever was found upon x-rays was used only as corroborative evidence a ong with the physical findings. Impinging transverse processes, sacralization, and lumbarization were anomalies suggesting undue leverage in either sacro-iliac or sacrolumbar areas. The "anomalous" planes of the articular facets of the lumbar spine produce mechanical conditions which limit the motions and concentrate the stresses upon the regions so frequently sprained. Increased horizontality of the sacrum increases the sheering stress in the lower lumbar spine and in the lumbosacral junction. Any deductions from measurements of the lumbosacral angle are liable to lead one to error. In this series (Table V), wherein the lumbosacral angle was measured (after the method of von Lackum[19]), it was found that the actual relation between the angle and the horizontality of the sacrum was slight. In many instances where the sacrum lies quite horizontally, it was seen that the accompanying lumbar lordosis made the angle measurement approximately that of a normal; again, it was frequently seen that the lumbosacral angle might be ten to twenty degrees from the normal and still show a sacrum in quite the normal oblique plane. It is, therefore, important, as von Lackum points out, to appreciate the fact that in increased horizontality of the sacrum, the sheering stress is increased not only at the lumbosacral angle, but also at the junctions of the fourth and fifth, third and fourth, and second and third lumbar vertebrae. In studying anteroposterior roentgenograms of the lumbosacral spine, the stereoscopic plates are of greatest value, and only with careful study can one be sure whether or not there is impingement of the fifth transverse process, and whether or not the articulations are normal.

TABLE VI

CONGENITAL ANOMALIES OF LUMBAR AND SACRAL SPINE FROM X-RAY READINGS OF TWO HUNDRED CASES OF SACRO-ILIAC AND SACROLUMBAR SPRAIN

	No. of Cases	*Per cent.*
Sacralization	18	9.
Lumbarization	13	6.4
Spina bifida:		
Of upper sacrum	52	26.0
Of lower lumbar	12	6.0

OTHER CONGENITAL ANOMALIES

	Number
Coccyx fused on one side with sacral scoliosis	1
Bifid lumbar spinous process of lumbar vertebrae	2
Separation of symphysis pubis	1
Lumbar ribs	2
Four lumbar vertebrae	1
Six lumbar vertebrae	3
Congenital scoliosis	1
Other irregularities at lumbosacral junction,—as cleft of fifth laminae or congenital irregularities of the articulations	26

In this x-ray study of 200 cases, particular attention was drawn toward the articulations of the lumbar and sacral spine. The familiar statement that the lumbosacral spine "is as variable as the individual's face" was found to be quite applicable. The typical anatomical textbook description of the articular facets shows most of the lumbar articulations facing the sagittal plane with gradual transition at the dorsolumbar junction and sacrolumbar junction to the oblique frontal plane. The variations are so common that they must for the most part be called normal. It is reasonable to believe that those spines showing very marked irregularities in the planes of the articulations have resultant limitation of motion in certain directions; and have increased motion with corresponding massed forces exerted upon other of the articulations. These x-rays were all from the cases of sacro-iliac and sacrolumbar sprain. Since we were unable to find a similar number of x-rays of symptomless spines for comparison, no statistical statement can be made concerning the value of these findings as etiological factors.

TABLE VII

ANATOMICAL VARIATIONS OF THE PLANES OF THE LUMBAR ARTICULATIONS (TROPISM) IN A STUDY OF ROENTGENOGRAMS OF 200 CASES OF SACRO-ILIAC AND SACROLUMBAR SPRAIN.

(Note: The degree of tropism depends upon the number of articulations showing variations in the plane of the contact surfaces.)

Degree of Tropism	*No. of Cases*	*Per cent.*	
1 articulation	40	20	(Slightly irregular 41%)
2 articulations	42	21	
3 articulations	30	15	(Markedly irregular 29%)
4 or more articulations	28	14	

60 x-rays showed "so called normal" planes of articulations 30%

Line drawings to illustrate the common variations in the planes of the lumbar articulations (tropism). Many combinations of these normal variations are seen in the roentgenograms of the lumbar spine. For statistics on tropism, see Table VII.

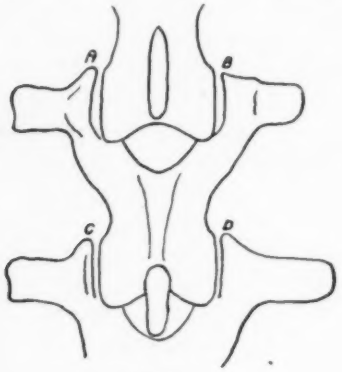

FIG. 1

A mid-lumbar vertebra, showing all articulations in the sagittal plane.

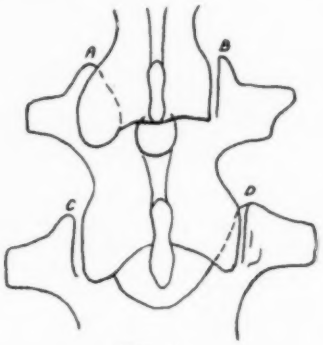

FIG. 2

A mid-lumbar vertebra showing articulations *b* and *c* in the sagittal plane, articulation *a* in the oblique frontal plane (more in frontal plane), and articulation *d* in the oblique sagittal plane (more in sagittal plane).

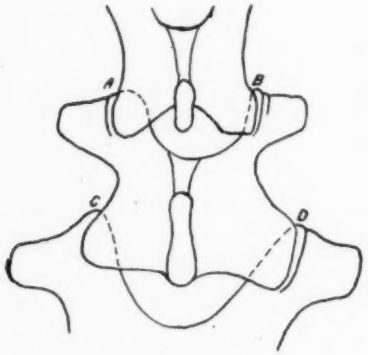

FIG. 3

A lower lumbar vetebra with articulations *a*, *c*, and *d* in the oblique frontal plane, and articulation *b* in the oblique sagittal plane.

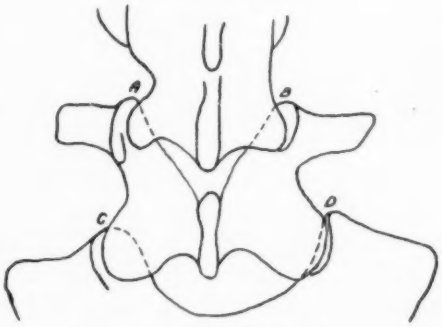

FIG. 4

Showing the articulations of the fifth lumbar vertebra. Articulations *a*, *b*, and *c* are for the most part facing an oblique frontal plane, while articulation *d* faces a sagittal plane.

The treatment of low back sprain by the orthopaedic surgeon is for the most part satisfactory. In all severe acute traumatic cases, either with or without complications,—as radiating pains, or postural anomalies—the patient is put on a stiff bed, sometimes with adhesive supporting, occasionally with a plaster jacket, but this less frequently because physiotherapy should be instituted as soon as possible. When there is much muscle spasm, head and pelvic traction or head and leg extension (adhesive straps) is indicated. Complicating sciatic radiation often responds nicely to traction therapy. Likewise, the asymmetrical posture, which is assumed by the patient either as a position of relief or from muscle spasm, will in

the course of time react favorably to the weights. The weights are gradually increased as the patient can stand them. While in bed, baking of the painful parts should be instituted. As the condition improves, heat, massage, and corrective exercises are indicated. Then, upon becoming ambulatory, external supports of the lower back are used. If adhesive taping or belts seem insufficient, more thorough immobilization by a carefully molded plaster cast should be given for a period of several weeks, and the patient may or may not be up and about with crutches, depending upon the tolerance for weight-bearing. Whenever pain is referred to one lower extremity, a part or all of that member may be included in the cast. In unilateral sacro-iliac cases, casts as the rule include the thigh on the affected side and the weight of the body should be carried on the uninvolved side.

In the cases of low back pain due to static faults, the routine is to correct the postural misalignment with a corset or a brace and to start a course of physiotherapy after the principles of Goldthwait. The latter[13] consists of corrective exercises with baking and massage to improve the circulation and tone of the weakened musculature. The treatment of these cases is aimed toward eliminating the static imbalance[14]. Muscle balance of the spine, thorax, and abdomen go hand in hand in the weakened states; hence, when managing the postural case, exercises must restore the balance, not of one, but of all three systems, if a permanent result is to be expected. Other static faults—as the "weak foot"—or such skeletal pathologic conditions as hip disease, knee joint disease, are to be considered in the care of the patient, as they frequently play an important rôle.

Manipulative treatment, under anaesthesia, is reserved for those resistant cases of sprain which after a reasonable amount of time fail to respond to recumbency and supportive measures. In several instances, manoeuvers after the method of Sir Robert Jones gave excellent results. The majority of the manipulations were those accompanying sciatic stretching, wherein the indications were made because of persistent sciatic pain. Stretching of the sciatic nerve is accomplished by completely flexing the hip while extending the knee in a patient who shows complete relaxation under anaesthesia. The pelvis is held firmly to the table. By this method considerable stretching force is exerted upon the sciatic nerve and upon the sacro-iliac and sacrolumbar ligaments. Occasionally one hears during these manoeuvers a loud pop or a cracking sound, the exact nature of which is questionable. It is presumed that these sounds are produced by the replacement of relaxed or subluxated sacro-iliac joints. In several instances of persistent sciatica, the injection treatment with novocain and normal salt solution was tried. The relief was of short duration, lasting usually two or three days. The relief after stretching of the sciatic nerve in this series was permanent in fifty per cent. of the cases. Following the stretching, the patients were supported by adhesive tape about the lower back, with Buck's traction on the affected side, or in the more severe, by plaster-of-Paris cast. A few days after the pain has been completely relieved, the

patients are allowed up on crutches. Casts may be worn for two to four weeks. Active physiotherapy is instituted as early as possible.

Operative treatment was reserved for those inveterate cases which failed to respond to all efforts by conservative methods. The methods of Gaenslen and Smith-Petersen[15, 16] were used in the fusion operations upon the sacro-iliac joints, each with equally good results. Fusion of the sacro-iliac articulations was used for persistent sacrolumbar sprain[17, 10].

TABLE VIII

RESULTS OF TREATMENT OF 281 CASES

(Observed from 1 to 10 years)

	Supports, Belts, Casts, Braces			Recumbency and Traction			Manipulation, Stretching			Operative fusion			Total
	Good	Fair	Poor	Good	Fair	Poor	Good	Fair	Poor	Good	Fair	Poor	
Sacro-iliac	83	21	8	11	1	4	8	5	3	8	1	0	153
Sacrolumbar	44	4	13	5	0	2	1	0	0	1	0	0	69
Combined	30	8	6	6	4	2	0	1	0	1	1	0	59
												Total	281

COMMENT

1. In acute cases of sacro-iliac and sacrolumbar sprain, trauma, posture, and occupational factors are the most important considerations in the etiology.

2. In the chronic cases,—*i.e.*, those in which the symptoms persist over six months—the differentiation from chronic arthritis becomes very difficult. Only with a careful history and a thorough physical examination can referred pain be ruled out. In certain chronic cases, the local arthritic symptoms plus a suspicious history must be the basis for the diagnosis, and the patient consequently treated as arthritic.

3. The differential diagnosis between sacro-iliac and sacrolumbar sprain is based upon: (a) local points of tenderness which are anatomically separate; (b) localization of the pain (subjective); (c) the use of special tests as the Laguere, Goldthwait, and Gaenslen tests, straight leg raising, and forcible compression of the iliac crests.

X-ray findings are not particularly important in the differential diagnosis and can be used only as confirmatory evidence after the diagnosis is made by the history and the physical findings. Anatomical variations of the planes of the lumbar articulations (tropism) as well as impinging transverse processes are mechanical conditions which favor low back sprain, especially the sacro-iliac type. Tropism is more common than previously supposed. Measurements of the lumbosacral angles vary considerably. The angle in increased horizontality of the sacrum depends entirely upon the amount of compensatory lumbar lordosis. In most instances, as the

sacrum is more horizontal, there is more lumbar lordosis with resultant increase of the sheering stress between the articulations of the lower three lumbar vertebrae as well as the lumbosacral angle. Increased horizontality of the sacrum and increased lumbar lordosis predispose to lower lumbar and lumbosacral sprains.

4. Radiating pains are variable in either sacro-iliac or sacrolumbar sprain and they may be in the distribution of the sciatic nerve, in the area supplied by nerves of the lumbar plexis, or in the path of the gluteal nerves. The exact etiology and pathology of referred pain is not understood.

5. The lumbosacral case uncomplicated will not show a list. The sacro-iliac case frequently shows a contralateral list, or if there is a complicating sciatica, the tilt may be homolateral.

6. The essence of the treatment in the acute cases is complete and sufficient rest. Supports, belts, casts, braces, recumbency, and traction may be used in the chronic cases. Physiotherapy is recommended for all cases. Manipulation of the spine and sciatic stretching give good results in selected cases. In chronic persistent cases of lumbosacral and sacro-iliac pain, operation is advised.

We wish to express our appreciation for the helpful guidance of Dr. A. Steindler, through whose generosity this publication is made possible. To Dr. Henry Prentiss we are indebted for certain anatomical conceptions, and to Dr. Gibbon we owe thanks for his help in procuring roentgenograms. We also wish to thank Dr. John LeCocq for his help in some of the statistical studies.

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DISLOCATION OF THE FEMUR UPON THE ACETABULAR NOTCH IN A PRE-ROMAN BRITON

BY DR. M. F. ASHLEY-MONTAGU, LONDON, ENGLAND

Dislocations of the femur upon the acetabular notch, as distinct from the obturator foramen or the pubis proper, are comparatively rare; still more rare are permanently established cases of this species of dislocation. In fact, I know of no recorded case of such a condition in the literature. It is not, therefore, without some pleasure that I am able to communicate a case of permanently established dislocation of the femur upon the acetabular notch; which at the same time exhibits, in a most remarkable manner, the changes which have taken place in the structures concerned, in adaptation to the new conditions; illustrating too, in a beautiful way, the relation between form and function.

In this instance a portion of the ilium and pubis belonging to the right side of the body is all of the pelvis that remains, apart from the acetabulum. The head of the femur, which remains freely but irremovably lodged in its new acetabulum, carries with it but a third of its shaft, the other two-thirds having been broken away *post mortem*.

From the character of the bone, in certain parts of which the cancellous matter is exposed, from the nature of the epiphyseal region at the head, and certain other characteristics, it is to be inferred that the age of the individual to whom these bones belonged did not exceed fifty years. An examination of the skull (which reveals many recently healed wounds) would indicate an approximate age of forty years. The sex is almost certainly male.

The skeleton, to which the bones here described belong, was excavated on May 15, 1865, from a barrow, of which it was the sole occupant, some fourteen miles east of York and about two miles west of Thixendale, England, and belongs to a period dating back some 5000 years.[1] The bones are now in the possession of the Municipal Natural History Museum, Hull, England.

THE DISLOCATION DESCRIBED

It would seem that by some means the superior frontal surface of the head of the femur had come to rest against the acetabular notch, and by a necessary adaptation a new acetabulum was gradually formed in order to accommodate it. The following changes are to be observed in the bones involved: A new acetabulum has been formed, almost completely obliterating the old, which latter is represented superiorly by a horizontal crescentic-shaped cavity which is filled with numerous osteophytes. (See Fig. 1.) The new acetabulum, due to an upward and forwardly directed

FIG. 1
Anterior view.

FIG. 2
Lateral view.

pressure of the femoral head, has made a profound inroad into the bone of the inferior ischial area, which in this region presents an inflated half-globular appearance and which is further filled out inferiorly by a great exostosis. This exostosis takes its origin from the superior ramus of the pubis and projects considerably into the obturator foramen. This delimits the outer surface of the new acetabulum, the internal dimensions of which are: diameter, fifty-eight millimeters; depth, sixty-eight millimeters.

When the femur is accurately oriented in relation to the pelvis, it is seen that the head of the bone has been appreciably altered in the plane of its direction, being displaced through some fifteen degrees posteriorly, a change which brings the shaft of the bone into a normal position. The head is somewhat enlarged, its superior surface being highly polished, as is also the whole area of the acetabular fossa. The same areas are both extremely porotic.

FIG. 3
Posterior view.

FIG. 4
Median view.

The anterior ventral surface of the femoral head is marked by a growth of cancellous tissue which had developed inferiorly upon the neck to form roughened osteophytes. The trochanters show no abnormal changes, excepting perhaps that the lesser trochanter is rather flatter than usual. The surface giving attachment to the pectineus, adductor magnus, gluteus maximus, and vastus lateralis, is considerably roughened. The anterior surface as far as the terminal portion of the vastus intermedius is comparatively smooth. The regions giving attachment to the vastus lateralis and the gluteus minimus are however, very rough, and at the intertrochanteric line there are appreciable osteophytic growths. Upon the anterior surfacé of the neck, immediately above the intertrochanteric line, two large exostoses are discovered, the inferior measuring twenty-four by sixteen millimeters; both are excavated posteriorly for some ten millimeters in a median direction (See Fig. 2). The superior exostosis presents a curved conical appearance, the now perpendicular base of which is excavated to

form a sinus. The function of these structures was apparently to serve as buffers against the margin of the acetabulum. Upon the posterior surface at the intertrochanteric line there are some small osteophytic growths and a few foramina.

All these new structures have arisen, quite clearly, in response to new functional demands,—a roughening of the bone to give greater leverage to muscles, an inclination of the femoral head to give the leg its most efficient orientation, the development of exostoses upon the neck to prevent the head from sinking too deeply into the yielding acetabulum, and finally an adaptation of adjacent structures to form a new acetabulum in which to hold the head of the femur.

During the lifetime of the individual, I think, there must have been but the slightest, if any, eversion of the limb, which could probably be flexed perfectly, as well as rotated in any direction. There can be little doubt, however, that this limb was slightly longer than its fellow. In *The Lancet*, 1845, Dr. Edwyn Gurney reports a case of a laborer with a similar dislocation of the hip joint, who was able to walk a considerable distance shortly after the accident, the functions of the limb not being appreciably impaired during the continuance of the dislocation. W. Cadge in *Medico-Chirurgical Transactions*, 1855, gives an account of a case of femoral dislocation upon the pubis of old standing, in which a unique acetabulum had been formed above the inferior spinous process. In this case, however, it is evident that the normal functions of the limb must have been seriously disturbed.

In conclusion I have to thank Mr. T. Sheppard, the Director of the Hull Natural History Museum, for putting these bones at my disposal during a flying visit which I made to that city, and I wish also to thank Mr. G. K. Beaulah, Assistant at the Hull Museum, for the very beautiful drawings he has made to illustrate this paper.

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THE MODIFIED BIFURCATION OPERATION FOR THE TREATMENT OF PAINFUL CONGENITAL DISLOCATION OF THE HIP

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The bifurcation operation described by Lorenz in 1919, a development from the subtrochanteric osteotomy for use in the adolescent dislocations of the hip and painful subluxations in adults, in many cases gives marked relief; in others, however, but little improvement, and it is sometimes performed only with considerable difficulty. The lower fragment, with its projecting bony point, is frequently slow in producing a firm union with the upper end of the diaphyseal fragment, and is often in poor position to follow the movements of the femur; cases are reported of injury to the femoral vessels. The projecting point sometimes disappears, and the femur loses its point of support in the cotyloid cavity.

Galland,[1] of New York, in a recent excellent article, described a procedure which establishes a stable, movable, and painless hip, not by producing a new articulation by remodelling, but by establishing a nearthrosis, which underlies the coxofemoral articulation,—always greatly changed—by carrying further below, on the femoral diaphysis, the support of the body weight. This is applicable to those cases in which activity is not possible and for which the operation of bifurcation alone is not so well adapted.

The bifurcation operation above mentioned, combined with the bony support, has accomplished what we have hoped; it has been employed by us successfully in two cases and merits attention, particularly as the procedure is simple. These two cases were of unilateral subluxations, and as the bifurcation operation with the support of the head had given satisfaction in a bilateral case, it was thought that this procedure was desirable in these two.

Operative technique: The patient, under anaesthesia, is immobilized on an orthopaedic table in such a way as to avoid movement in the horizontal plane, in order to insure the placement of the fragments in the desired position without forcible manipulation, and the retention of the fragments. It is necessary to have the radiographs at hand in order to determine the bony relations, especially the distance which

FIG. 1

Here may be seen the difference between the double support given by the bifurcation with the shelf over the head and the bifurcation alone.

FIG. 2

The appearance of bone sections as prepared for the support of the bifurcation and of the head.

separates the upper portion of the greater trochanter from the lesser and lower, and to determine on the skin the level of the lesser trochanter. Galland insists on determining the exact position and relation of the lesser trochanter before performing the osteotomy. This precaution we endorse, for it allows the osteotomy without injury and with a simple incision, and reduces to a minimum the first stage of the operation.

First stage: A transverse linear osteotomy, according to Broca, is made by partial section through the lesser trochanter, and fracture completed by the abduction of the leg. This osteotomy forms a Y with unequal branches, of which the shorter—the diaphyseal—is pressed back against the cotyloid cavity, the inner periosteum remaining intact. This sleeve is preserved, and the fragments held in contact by the tendinous insertions, which is important for the ultimate consolidation.

Second stage: With the patient on the side, the incision of Smith-Petersen is made, which allows the exposure of the femoral head and of the capsule, which is always distended and often thickened. The pad of Nové-Josserand is used, and the upper portion of the femur is lowered as much as

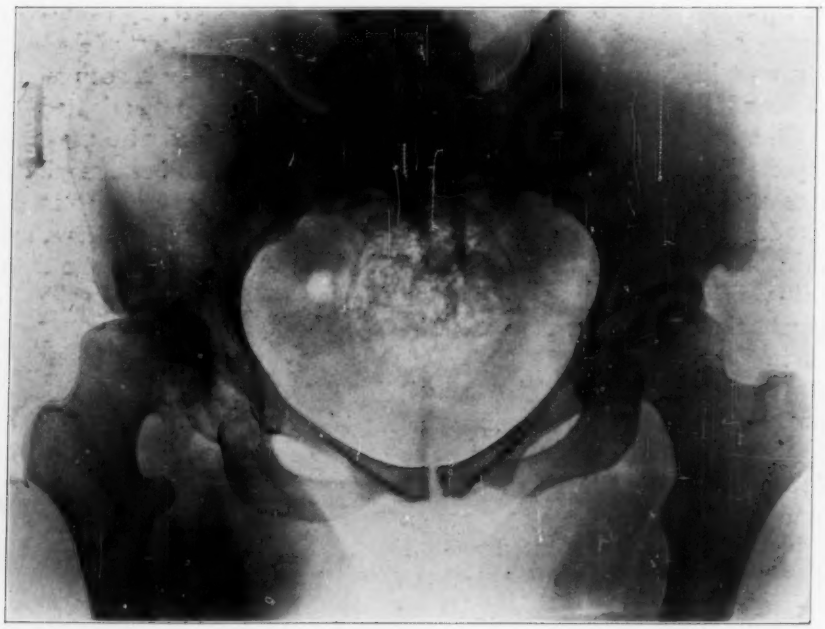

FIG. 3

Before operation. The head of the femur is seen to be forward and upward, just under the iliac spine.

possible. It is always possible to gain several centimeters, for it is only the upper extremity of the femur which is in question and which has been separated by the osteotomy from the diaphysis. From the external surface of the ilium a plate of bone is cut, which is turned downward over the head of the femur so that the upper fragment of the femur is in direct contact with the external surface of the pelvis (Fig. 2). A large plaster is applied, with the patient still fixed on the table, with the leg abducted and inwardly rotated.

At the end of three months consolidation is complete and the x-ray allows inspection of the position of the fragments and the development of the bony support. The patient is then allowed to begin walking, and for precaution a light spica is used, allowing the knee free and permitting weight-bearing in this new relation of the femur and the pelvis. Physiotherapy for about six weeks is usually necessary to overcome the stiffness and to permit the muscular development, and at this time the consolidation is complete, the hip is painless and supple, and the patient is soon able to walk with a cane.

Two cases are reported in which this procedure was used:

CASE 1. Mme. B., thirty-two years of age, with right subluxation; confined to bed because of pain; subject to painful crises. In childhood there had been an unsuccessful attempt at reduction which had resulted in anterior transposition. Examination

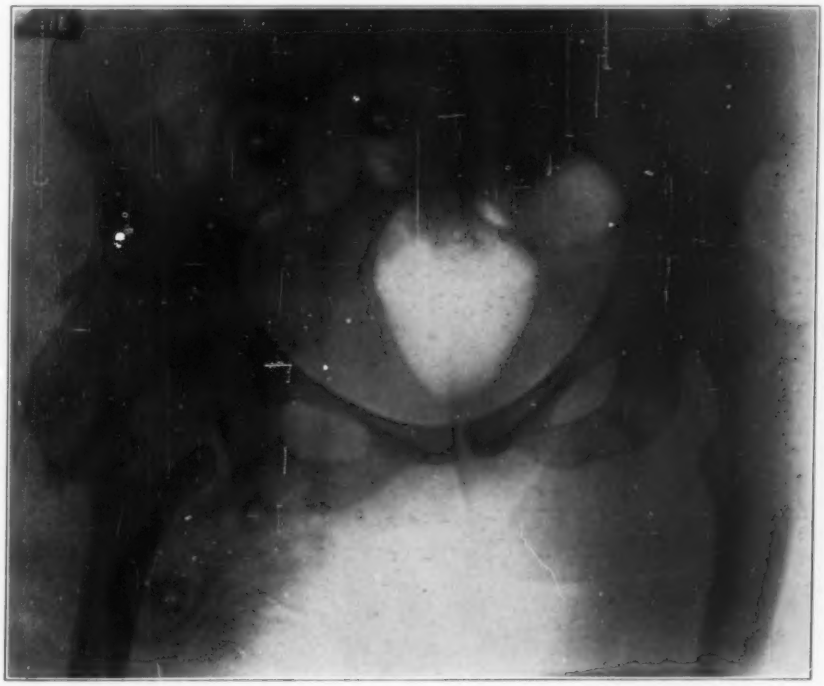

FIG. 4

After operation. The bifurcation is made at the level of the trochanter and a shelf has been placed above the head, thus creating a double prop.

FIG. 5

Before operation. The head of the femur is seen to be in a position backward and upward in a false cotyloid cavity.

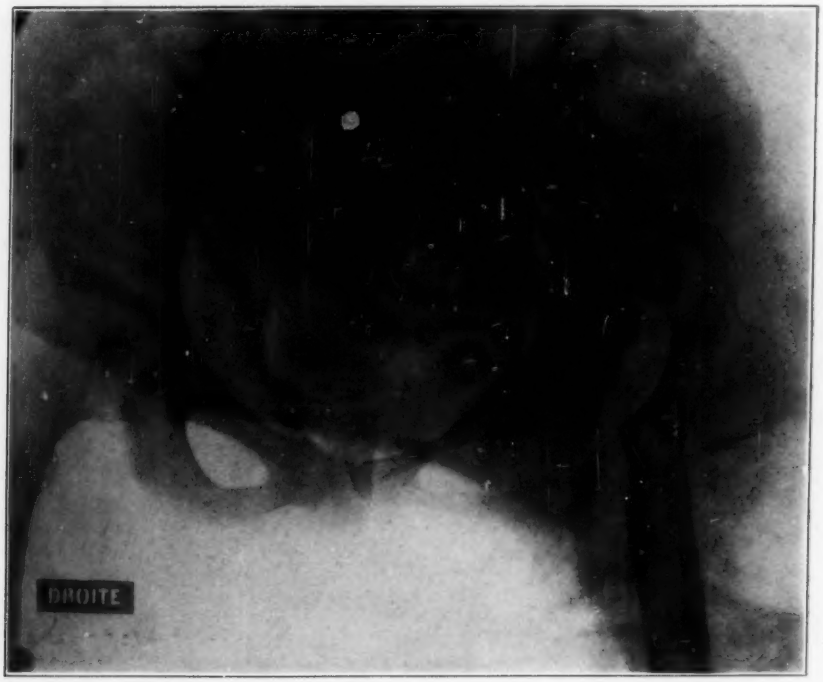

FIG. 6

After operation. The bifurcation may be clearly seen. The shelf placed behind and above the false cotyloid for support of the head is hidden by the iliac bone.

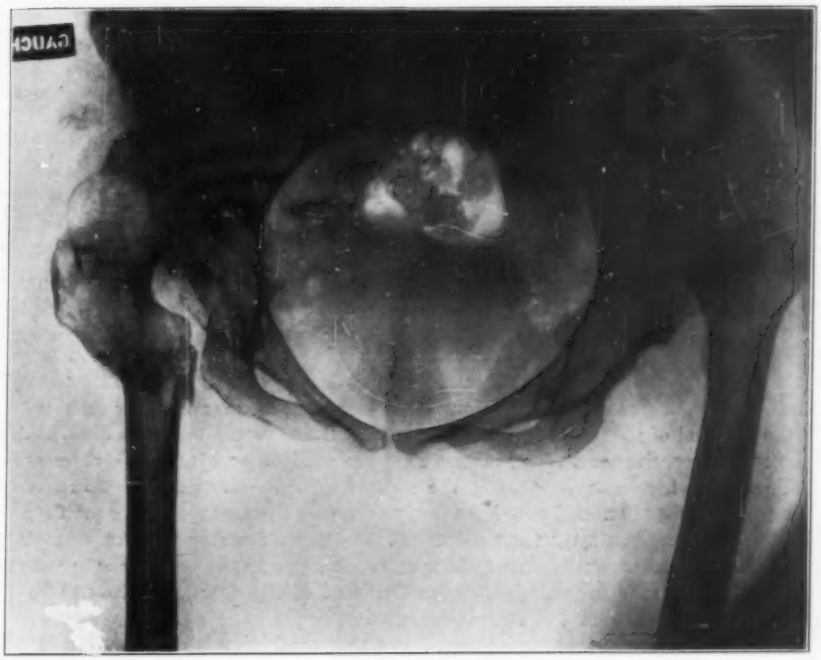

FIG. 7

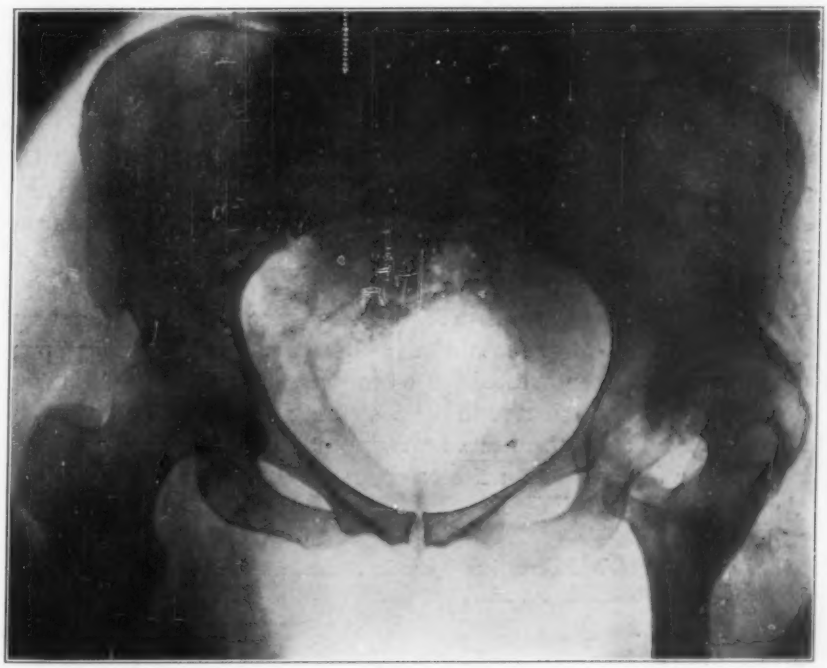

FIG. 8

Figs. 7 and 8. Results of bifurcation with shelf, operated upon more than a year ago. The patients walk without pain.

showed the femoral head below and to the outside of the anterior spine, painful to palpation, the leg slightly adducted, externally rotated, with flexion of the thigh on the pelvis. The movements were painful; full extension of the leg was not possible, and abduction partially restricted. (Fig. 3.)

At operation, the femoral head was first exposed to examine the lesion and to determine the technique to be followed. The capsule was exposed by the Smith-Petersen incision, and was found to be thickened and distended, with the head freely movable within and with no point of direct support between the head and the ilium. The head was flattened, irregular in contour, and with anterior torsion of the neck. The greater trochanter was posterior to the head and prominent in the buttock. It was evident that the bony point of the usual bifurcation operation would not give sufficient support, and moreover it would be necessary for it to be made far anterior and subcutaneously. It was impossible to change the position of the head by any attempt to obtain support for the head on the ilium; it was then decided to separate the upper femoral extremity, with the object of making a bifurcation. The technique as described was followed.

On removal of the plaster three months later, the x-ray showed firm consolidation of the osteotomy, the point of the bifurcation gave good support by the short branch of the Y, and the long branch—that is, the upper fragment—showed a firm angulation, resting against the ilium, and afforded a firm support by the osseous band over the head (Fig. 4). With a short spica the patient was able to walk easily, without pain, and it could be seen that the movement of the femoral head was in the axis of the movement, and the slight motion in the joint was at the level of the nearthrosis formed by the branch of the Y at the level of the cotyloid cavity.

Case 2. Mlle. G, seventeen years of age, unilateral left subluxation (Fig. 5), with marked disability, painful, showed shortening of seven centimeters, with the head posterior and without support, which gave a waddling gait. The lumbar curve with the prominence of the head produced an asymmetry of the pelvis and the vertebral column.

Operation, according to the technique described in two stages, was carried out. The support was removed at the end of two months. Union was firm; the x-rays showed good consolidation of the osteotomy and the bone buttressed above the femoral head (Fig. 6). The patient was allowed to begin walking with a plaster.

In the two cases of unilateral painful disabling subluxation, there resulted painless and useful joints by supplying the double support from the femoral head and the diaphyseal branch. In these cases the osteotomy was made high, at the level of the lesser trochanter, with the branch of the Y supported against the cotyloid cavity very short.

The term "bifurcation" is retained, since the bifid position of the upper portion is necessary to give a satisfactory support. By operating in this manner, the inconvenience of the bifurcation with the long spur is avoided and the advantages of the osteotomy are retained. A factor in the success must be attributed to the projecting bone, which holds in place the femoral head and furnishes a firm support to the branch of the Y, and this has had a favorable influence on the rapid consolidation of the section of the femur.

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SPONDYLOLISTHESIS*

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Subluxation of the lumbar spine, "spondylolisthesis", is of especial interest to the orthopaedic surgeon as either a congenital or a traumatic factor in the etiology of pain in the lower part of the back, and of deformity. Of the 125 cases reported previous to 1900, all but six were reported by obstetricians. With the use of the roentgen ray and careful manual examination of the spinal column the condition has been found with equal or greater frequency in men than in women, and this led to the solution of baffling complaints in the lumbosacral region. Pain in the lower part of the back, relieved by rest, aggravated by work, and associated with industrial injury, suggests the possibility of railroad spine, traumatic neurosis, and so forth; yet these disorders are commonly complained of by patients with spondylolisthesis whose appearance is often apparently normal and who seem to be enjoying undeserved disability benefits. Present knowledge of this deformity makes it possible for the physician to recognize it, to ascribe responsibility to the factors involved in its production, and to relieve the symptoms to a large extent; yet in my experience less than five per cent. of such cases had been diagnosed previously.

Since the recognition of the deformity by Kilian, in 1853, an increasing number of cases has been reported; the number amounted to 125 in 1900. With improved roentgenologic technique and careful interpretation, a considerable percentage of congenital defects of the vertebrae has been shown to be associated with spondylolisthesis.

No doubt trauma is significant as a cause of spondylolisthesis, and obesity, pregnancy, and occupational strain may gradually produce it. Sudden severe injury may instantly cause subluxation with immediate disability and pain. Congenital defects, variations of the fifth lumbar vertebra and lumbosacral joint are, however, commonly noted during examination. Such defects do not always cause symptoms, but when trauma tests the stability and the strength of the structures, weakness is manifested by strain, subluxation, and deformity. With the present modern technique of making roentgenograms, defects of this type are more easily recognized, and spondylolisthesis is more readily distinguished from tuberculosis and other lesions. The lumbosacral joint slopes downward and forward in the erect position, usually about thirty degrees; study of the roentgenograms shows a great variation, even sixty degrees to the perpendicular. In such cases lordosis is usually marked, and pregnancy, heavy lifting, and obesity bring increased strain on the ligaments about the joint.

*Read before the American Orthopaedic Association, Chatham, Massachusetts, June 21, 1930.

With the superimposed weight of the body, it hardly requires further aid to cause stretching, and subluxation is made possible. However, the normal spinal column with its strong ligamentous support holds the inferior process of the fifth lumbar vertebra from slipping over the superior articular processes of the sacrum and, in the absence of fracture or congenital defect, rotation or forward displacement is difficult. Because of the evolutionary change from horizontal to perpendicular, and the late closure of the neural arches, the lumbosacral joint and the fifth lumbar vertebra are the sites of more anomalies than any other portion of the spinal column. Spina bifida occulta, separate neural arches, sacralized transverse processes, and a low-lying fifth lumbar vertebra are examples of this. In only a few cases was it possible to show that previous illness was a possible etiologic factor. However, in the presence of paralysis, general muscular weakness, and bony or ligamentous defects, it would require less severe trauma to produce displacement.

In the series of 121 cases observed at The Mayo Clinic from 1918 to June 1930, there were eighty-five male patients (62 per cent.) and thirty-six female patients. The average age of the patients was approximately thirty-seven years. The youngest patient was a girl, aged eleven years, and the oldest was a woman, aged sixty-seven years. The average age of the men was thirty-four years and of the women, thirty-nine years. The youngest patient operated on was a boy, aged thirteen years. Thirty-three patients were farmers, twenty-three were housewives, eighteen were clerks, sixteen were laborers, nine were students, six were railroad workers, five were mechanics, nine had professional occupations, and two had no occupation. Forty-seven (about 38 per cent.) ascribed the cause of the deformity to trauma. Seventy-four did not give a history of trauma and the onset of their trouble had, as a rule, been gradual, and the duration long,—from one to forty-six years. Fifty patients complained of backache, thirty-five complained of pain in the back and legs, fifteen complained of pain in the back and hips, nine complained of pain in the legs, three complained of pain in the hips, and nine complained of vague, indefinite symptoms and in the course of the routine examination only incidental data were elicited. Twenty-one of these patients complained of occasional numbness and four of weakness at times in the legs. Although backache was the most common complaint, there were an equal number who complained of referred pain to the hips and legs. Before examination, lumbago, sciatica, rheumatism, tuberculosis, and backache were commonly ascribed as the cause. The average duration of the complaint in this group was seven years; in male patients the average was seven and a half years and in female patients six and a half years.

Rest usually gave relief, but work, especially hard labor, aggravated the pain, which usually was of a dull aching character. Weakness and stiffness of the spinal column were commonly acknowledged when inquiry was made; only a few patients had noticed deformity, although shortening of the torso and decrease in height had occurred in many cases.

The clinical data which led to the diagnosis of spondylolisthesis were: lordosis with shortened torso, limited spinal motion and depression at the fifth lumbar vertebra, with prominence of the upper posterior border of the sacrum. In about seventy per cent. of the patients, depression of the fifth lumbar vertebra was noted. Limited spinal motion was noted in about fifty per cent., whereas definite shortening of the torso was noted in about eighteen per cent. The lordosis varied and was often accompanied by spasm of the muscles. Examination of the patient's back reveals apparent widening of the pelvis, the ribs may rest on the ilia, and there may be listing to one side or the other, or scoliosis. Spinal motion may be limited, especially on forward bending. The patient often walks with a careful gait. If there is marked displacement following recent injury, the gait may suggest the waddling type seen in cases of bilateral dislocation of the hips. With slipping forward of the entire spine and shortening of the torso, a crease develops across the upper part of the abdomen; palpation may then disclose the fourth lumbar spinous process below the iliac crests, and the fifth lumbar spinous process may not be evident. With marked displacement forward of the fifth lumbar vertebra, careful palpation or proctoscopic examination may reveal a hard, fixed mass in front of the sacrum.

With the foregoing clinical data, the diagnosis is made without difficulty. The diagnosis is made largely by inspection and palpation, by the depression in the region of the fifth lumbar vertebra, with prominence of the sacrum, by more or less spasm of muscles, and by limitation of forward bending, verified by roentgenograms. If there is marked forward displacement, the condition is readily recognized clinically. Roentgenograms, however, are of the greatest aid in determining the diagnosis, especially in the lesser displacements, and in distinguishing tuberculosis, fracture, congenital anomalies, and sacro-iliac disease. Jarring, jolting, and stumbling cause varying degrees of pain, but there is usually less spasm of muscle and rigidity of the spine than is seen in Pott's disease. A differential diagnosis of Pott's disease or spondylolisthesis can usually be made definitely with good anteroposterior-view and lateral-view roentgenograms, and by the history of the case.

Congenital anomalies are not uncommon; in about twenty per cent. of this series of cases spina bifida occulta was shown in the roentgenogram. One should not depend on the anteroposterior-view roentgenogram alone; the lateral view is of much greater value, and should be taken so as to include the lumbar spine and the sacrum. Stereoscopic roentgenograms aid materially in the study of congenital defects. In elderly patients osteoarthritis is not uncommon; this condition was shown in the roentgenograms for spondylolisthesis in fifteen per cent. of the series. In 107 cases there was subluxation of the fifth lumbar vertebra on the sacrum; in thirteen, subluxation of the fourth lumbar vertebra on the fifth lumbar vertebra; and in one case, subluxation of the third lumbar vertebra on the fourth lumbar vertebra. In the anteroposterior views shortening of the lumbar spine was noted; often only four lumbar vertebrae were shown with their transverse

processes. Marked density may be noted in the upper part of the sacrum and on close inspection the transverse process and the fifth lumbar vertebra may be seen showing through the sacrum as a curved area of increased density, the convexity pointing downward. The transverse process of the fifth lumbar vertebra may appear pulled upward distally. Roentgenograms of the entire spinal column occasionally show the lower border of the ribs below the iliac crests, the result of forward and downward displacement of the spine. The lateral views disclose varying amounts of forward displacement of the fifth lumbar vertebra on the sacrum. There is great variation in the lumbosacral angle (Fig. 1). It may vary as much as sixty degrees. The amount of displacement varies from almost negligible to almost complete dislocation of the fifth lumbar vertebra in front of the sacrum. Naturally this has a bearing on clinical observations, and unless the roentgenograms are carefully examined in the lateral view, the minor subluxation will be overlooked. In the study of the lateral-view roentgenograms, the spinal canal should be traced, as well as the anterior border of the lumbar vertebrae and the sacrum, in determining the displacement. If patients are obese, it may be difficult to make out the bony parts in the roentgenogram. It is of value in such cases to outline carefully the spinal column with a pencil, with a not too brilliant light behind the film.

Relief of symptoms is obtained quickly by complete rest, with the patient lying flat on the back on a rather firm bed. Traction and counter-traction are also sometimes of benefit. Attempts to reduce the displacement have been of no avail; under anaesthesia, however, in acute, traumatic cases it should be attempted and followed by a high double spica cast.

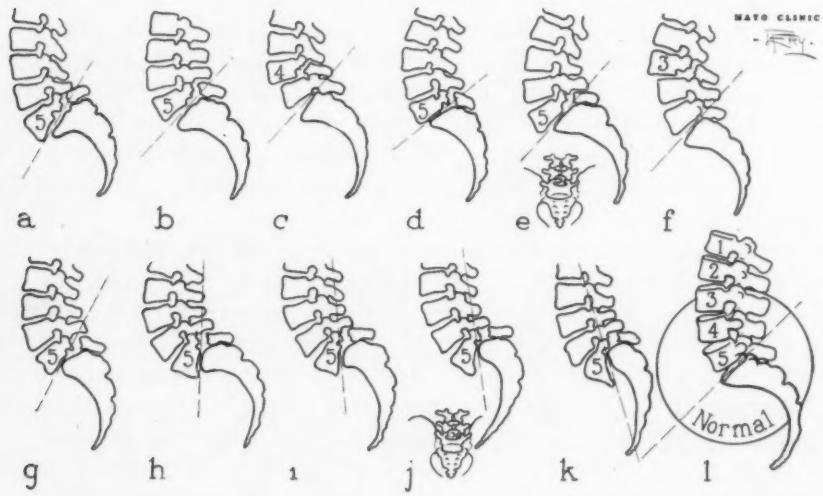

FIG. 1

Variations of the lumbosacral joint made from roentgen-ray tracings. The lumbosacral angle varies fully 60 degrees; the sacral articulation may be rounded and the fifth lumbar concave. The forward displacement varies from slight to complete. Separation of the laminae is common.

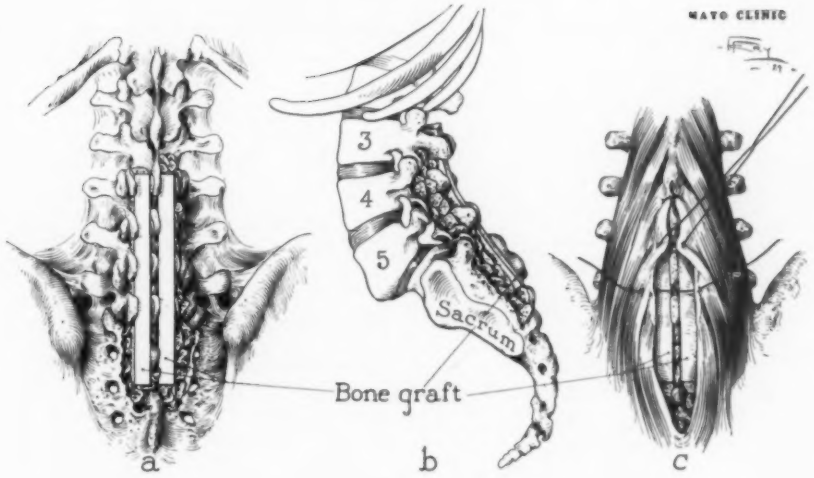

FIG. 2

Fusion in spondylolisthesis by double massive grafts, multiple chips, and cancellous bone includes the third, fourth, fifth lumbar vertebrae and the sacrum.

Most of our patients obtain relief from pain, and have a feeling of security and comfort when wearing a well fitted body cast. Many patients, especially of the obese type, prefer a corset with reenforced steel stays fitted well down back of the sacrum, instead of the cast. However, for those who must work and whose physical condition permits, surgery offers the most rapid and permanent means of relief.

Fusion is produced by exposing the spinous processes and the laminae of the third, fourth, and fifth lumbar vertebrae, and the upper part of the sacrum, and using multiple bone grafts. A thin layer of bone is split off from either side of the spinous processes, and the laminae are exposed and freshened by a curette and chisel, as in the Hibbs operation. A lead wire is used to obtain an impression of the shape of the grafts desired. Usually the tibia affords the best material. If possible, two grafts are made and inserted on either side of the spinous processes. Cancellous bone taken with a curette from the upper end of the tibia is packed between the laminae and the spinous processes, especially in the lumbosacral depression. To insure fusion to the sacrum this spongy cancellous bone is packed about the graft where it comes in contact with the sacrum. Bone chips from the tibia or spine are packed along the graft to fill the cavities (Fig. 2). With double chromic catgut the split-off bone chips from the spinous processes are pulled snugly against the grafts and the wound is closed without drainage. All bleeding is controlled by hot packs during the operation. Vessels are ligated, if necessary, and little postoperative hemorrhage occurs. A thick dressing of gauze and cotton saturated with alcohol is applied and held in place by adhesive straps; this seldom requires changing for two or three weeks. Plaster casts are not applied as a routine procedure, although during the first six weeks, while the patient is recumbent, a double spica

cast well up on the body adds security and permits the patient to move and turn. After six weeks the patient is permitted to be up; a cast or well fitted corset or brace is worn for four months.

Plaster casts, braces, and corsets are definitely beneficial when properly applied and worn. Manipulation has not been tried because of the long duration of the deformity, and attempts have not been made to reduce the displacement by open operation. The fusion operation is preferable unless the general condition of the patient contra-indicates a surgical procedure.

ILLUSTRATIVE CASES

CASE 1.—A man, aged forty-six years, complained of pain in the lower part of the back and thighs of seven months' duration. Seven months before he came to the clinic he fell down some steps, and sustained a severe injury to the lower part of the back, which resulted in pain of a sharp radiating character in the back and thighs. He was under medical care but the pain was so severe that he was unable to move. Paralysis was not evident. A few months later the patient was operated on for acute appendicitis. He was dismissed in about two months, greatly improved but not entirely well. He was unable to work because of constant pain, and disability in getting about. The question of disability came up because of compensation and the patient was referred to the clinic for an opinion as to the cause of his continued disability.

The patient was six feet in height and weighed 155 pounds, which was about twenty-five pounds less than his usual weight. Blood pressure, temperature, and pulse were normal. He walked with a careful gait and held the muscles of the back rigid; there was slight but definite stiffness in the lumbar portion of the spine. Slight kyphosis was noted over the fifth lumbar vertebra and a slight depression just above this. Spondylolisthesis was suspected and anteroposterior (Fig. 3*a*) and lateral-view (Fig. 3*b*) roentgenograms were taken, which disclosed the fourth lumbar vertebra displaced forward on the fifth, and spina bifida occulta. Urinalysis, chemical analysis of the blood, and the

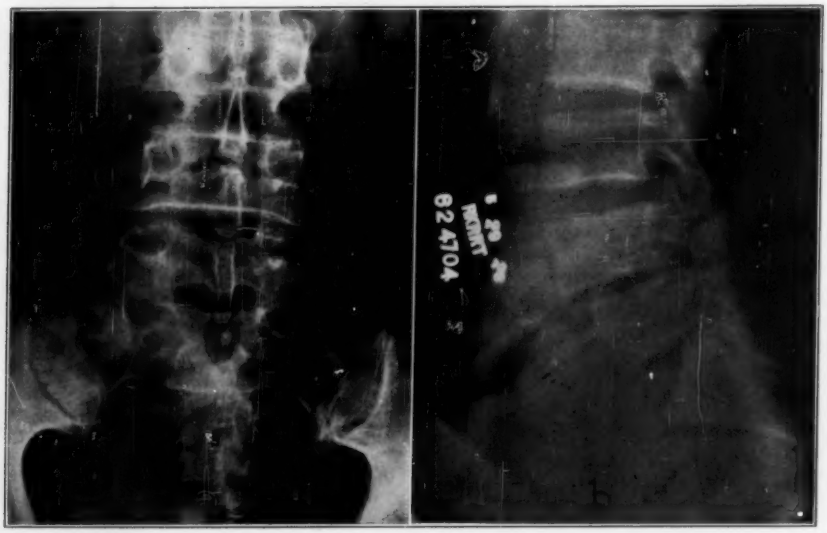

FIG. 3

Case 1. Traumatic spondylolisthesis. The fourth lumbar vertebra overlaps the fifth; spina bifida occulta; *a*, anteroposterior view; *b*, lateral view.

Wassermann reaction of the blood were negative. The tonsils were enlarged, but not definitely infected; two teeth showed evidence of periapical infection. Fusion operation was advised, and the insurance company and the corporation for which the patient worked were notified. The patient returned home wearing a belt, which gave him some benefit. The case was reconsidered by the compensation board, the compensation was renewed, and the patient was referred back to the clinic for operation.

June 1, 1928, an autogenous bone graft was placed so as to fuse the sacrum and the third, fourth, and fifth lumbar vertebrae. Convalescence was uneventful and July 18 the patient was dismissed, free from pain. A letter received subsequently stated that he was feeling well.

The lesion in this case is uncommon, as it involved the fourth and fifth lumbar vertebrae, whereas usually the fifth vertebra is displaced forward on the sacrum. The depression, therefore, in this case, was over the fourth lumbar vertebra, the fifth spinous process projecting backward. As the whole spine is carried forward, the sacrum seems unusually prominent and if the displacement is very marked the pelvis appears broad and the torso short. This patient was looked on as a possible malingerer until the true diagnosis was discovered. The value of a good lateral-view roentgenogram cannot be overestimated. Bone grafting in this case seemed to give early and almost complete relief.

Case 2.—A boy, aged nineteen years, complained of having had pain in the back for two years, which had been ascribed to rheumatism. Pain and swelling in the other joints substantiated the fact that complicating arthritis was present, but on examination the short waist, the depression over the fifth lumbar vertebra, the spasm of muscles, and limitation of motion led to a clinical diagnosis of spondylolisthesis; this was verified by roentgenograms. The entire fifth lumbar vertebra was displaced forward so that the posterior quarter of the body rested on the anterior part of the sacrum. Spina bifida

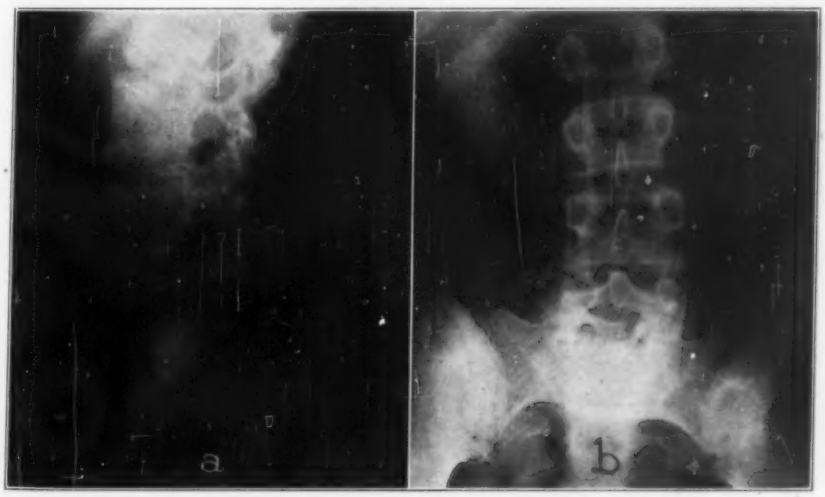

Fig. 4

Case 2. *a*, Spondylolisthesis of the fifth lumbar vertebra on the sacrum and spina bifida occulta; *b*, complete forward displacement of the fifth lumbar vertebra is shown on lateral view.

occulta was evident in the anterior views (Fig. 4 *a* and *b*). The patient was operated on in 1926; bone was grafted and the symptoms in the back were relieved.

Case 3.—A girl, aged nineteen years, complained of backache, soreness, and occasional numbness in the legs of four years' duration. The onset had been gradual; there was no history of trauma. During menstruation and on exercise, especially walking up steps, the pain was aggravated. A diagnosis had not been made. She wanted to marry, but feared to because of her disability. She came a considerable distance for aid.

Examination disclosed a well nourished girl with marked lordosis, broad pelvis, shortened torso, and depression over the lower lumbar vertebrae. There was tenderness about the lumbosacral and sacro-iliac joints with limitation of motion, especially forward bending. The blood count, the Wassermann test of the blood, and urinalysis gave negative results. Spondylolisthesis was diagnosed and verified by roentgenograms. The anteroposterior views showed the transverse processes of the fifth lumbar vertebra to be behind the sacrum, and increased density due to forward displacement of the fifth lumbar vertebra was typical (Fig. 5*a*). The lateral view showed the posterior border of the fifth lumbar vertebra resting on the anterior lip of the sacrum; the lamina and the spinous processes were apparently congenitally deformed, or were separated from the body (Fig. 5*b*).

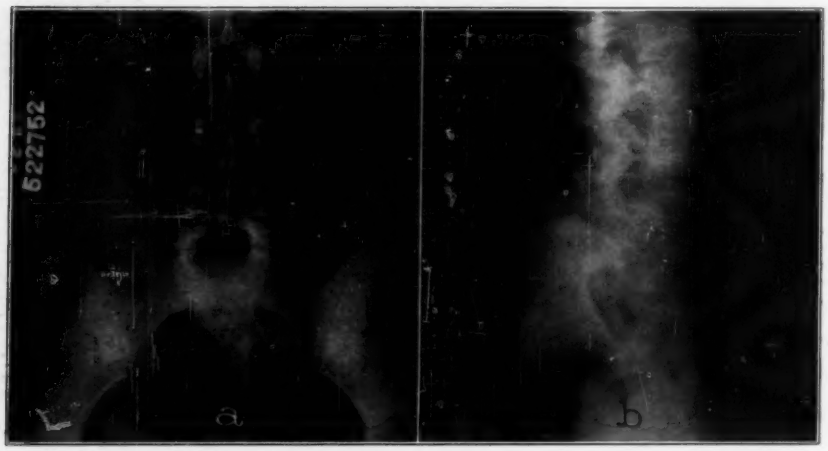

Fig. 5

Case 3. *a*, Spondylolisthesis of the fifth lumbar vertebra on the sacrum (anterior view). The fifth lumbar vertebra is low-lying and the transverse processes are behind the sacrum. Increased density may be noted. Two distinct curved shadows, convexity downward, show the anterior lip of the sacrum and below it the anterior border of the fifth lumbar vertebra. *b*, Spondylolisthesis of the fifth lumbar vertebra on the sacrum (lateral view). Almost complete forward displacement of the fifth lumbar vertebra; just the posterior border rests on the sacrum. The fifth spinous process is apparently separated and remains behind. *c*, Postoperative anteroposterior view of region of fusion operation. Spondylolisthesis of the fifth lumbar vertebra on the sacrum two and a half years after operation.

Operation, in October 1925, consisted of double grafts, chips, and cancellous bone to fuse the third, fourth, and fifth lumbar vertebrae and the sacrum. Roentgenograms three and five years after operation showed splendid fusion (Fig. 5*c*). The patient married. In an accident, the left sacro-iliac joint apparently was wrenched, but the point of fusion was not injured.

Case 4.—A boy, aged seventeen years, consulted the clinic because of pain and aching in the left hip. He stated that he had fallen down twelve steps about three years previously. A year later partial disability had developed and he was unable to do work which required stooping, as working in the fields. Because of the backache, he had consulted a surgeon, and arthrodesis of the left sacro-iliac joint had been performed. Two years after the incapacity had appeared, he came to the clinic because of pain and increasing disability.

Examination disclosed a short torso, with the ribs resting on the iliac crest, and marked lordosis. There was prominence of the first sacral vertebra with depression over the fifth lumbar vertebra. A clinical diagnosis of spondylolisthesis was verified by roentgenograms which further disclosed the presence of spina bifida occulta and failure of the laminae to close (Fig. 6). The patient was referred to his physician, who performed fusion operation with benefit.

Fig. 6

Spondylolisthesis. Complete forward displacement of the fifth lumbar vertebra (lateral view).

SUMMARY AND CONCLUSIONS

1. These data do not bear out observations by others, that spondylolisthesis is more common in females; about sixty-two per cent. of the patients in this series were men.

2. Trauma appears to be a significant factor in the etiology, although the frequency of congenital defects and the apparent instability of the lumbosacral joint are additional factors. About thirty-eight per cent. of the patients ascribed the cause to trauma.

3. Spondylolisthesis may be partial or complete, with variations of the lumbosacral angle.

4. Symptoms are mainly backache, which comes on either gradually or suddenly; if suddenly, severe trauma is usually associated.

5. The absence of symptoms with the patient at rest, and aggravation of pain on exertion are characteristic.

6. Shortening of the torso, lordosis, and a broadened appearance of the pelvis are common observations.

7. Prominence of the upper posterior border of the sacrum is present to a varying degree.

8. Depression due to displacement of the fifth lumbar vertebra with local tenderness is common.

9. The anteroposterior diameter of the pelvis is lessened, thus narrowing the birth canal.

10. The neurologic signs are usually paresis and modified sensation, limited commonly to the fifth lumbar vertebra and the first sacral segment. Complete paraplegia at this level is impossible unless severe trauma has injured the cord at a higher level. Pain and paraesthesia over the saddle area may be present.

11. Stereoscopic or lateral-view roentgenograms are best, as the anteroposterior-view roentgenograms may not disclose the lesion.

12. Patients are treated by casts, braces, corsets, or fusion of the third, fourth, and fifth lumbar vertebrae and the upper part of the sacrum.

OPERATION FOR CORRECTION OF PARALYTIC GENU RECURVATUM*

BY A. BRUCE GILL, M.D., PHILADELPHIA, PA.

Excessive genu recurvatum occurs relatively infrequently in anterior poliomyelitis.

Much more commonly is seen a flexion contracture of the knee. With this contracture is usually found a greater or less degree of genu valgum with shortening of the iliotibial band and external rotation of the leg below the knee. This combination constitutes a serious handicap to locomotion. The patient is able to walk without support if the extensor muscles of the hip are strong. If they also are paralyzed the patient can walk only by holding his knee back with his hand or by the use of a lock-joint brace. One of the most common operations which the author employs in the correction of deformities due to infantile paralysis is an osteotomy of the femur to correct knock-knee and to make a back-knee. With this may be combined, if necessary, a stabilizing operation on the foot to check dorsiflexion of the ankle.

An excessive amount of back-knee has resulted from such an osteotomy in four known cases out of one hundred and fifty. At the beginning the degree of back-knee may be only slightly more than is necessary for stabilization of the knee, but it is very apt to become worse with continued weight-bearing. The posterior ligaments of the knee gradually become more and more overstretched until marked deformity and weakness result.

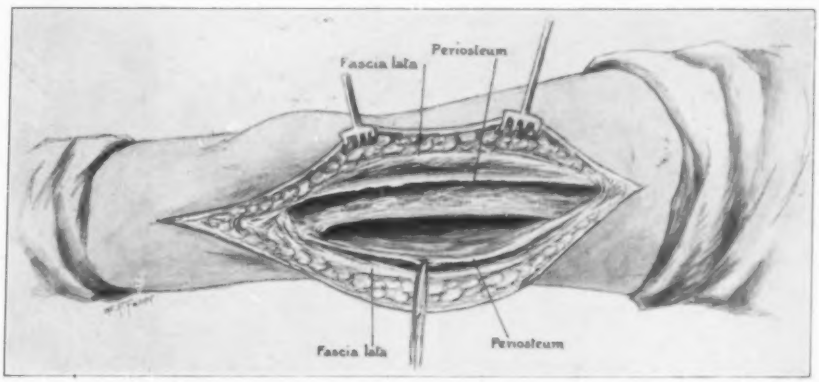

FIG. 1

Shows incisions through skin, fascia lata, and periosteum, and detachment of posterior portion of the periosteum.

*Presented at the Annual Meeting of the American Orthopaedic Association, Chatham, Massachusetts, June 21, 1930.

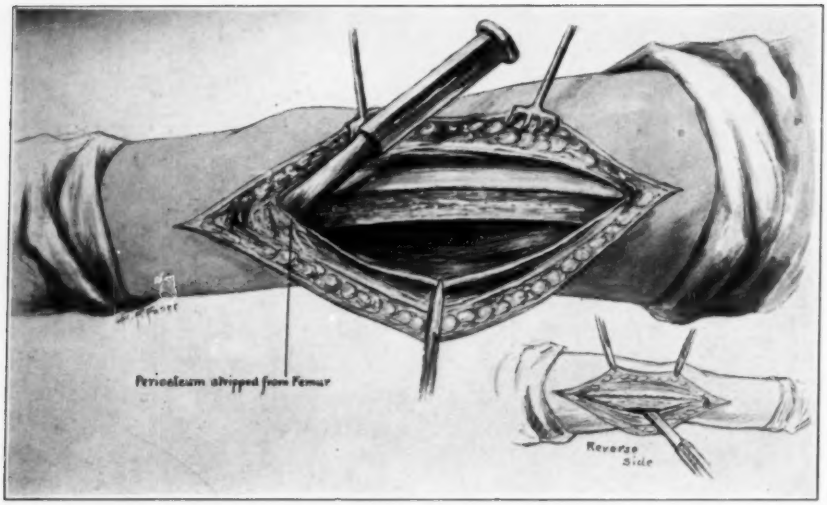

FIG. 2

Shows how the periosteum and lateral ligaments are detached.

Occasionally are seen cases of this same deformity that have developed *per se* as a result of the paralysis. It usually can be prevented if during the early years following the attack of infantile paralysis a flail knee be protected with a brace.

For many years the author had observed this disabling deformity without knowing what to do to correct it. It is due to weakness of the soft structures which support the knee posteriorly. An arthrodesis of the knee will cure the condition, but will subject the patient to the manifest dis-

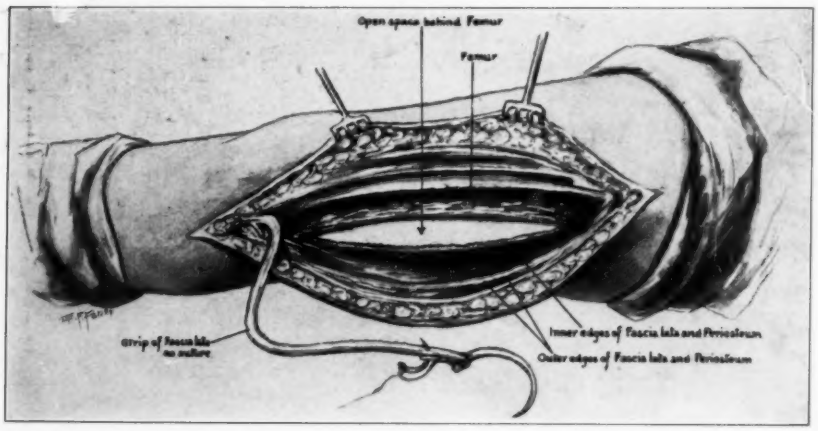

FIG. 3

Shows how periosteum has been freed completely from femur, so that its lateral edges together with the edges of the fascia lata may be sutured together behind the femur.

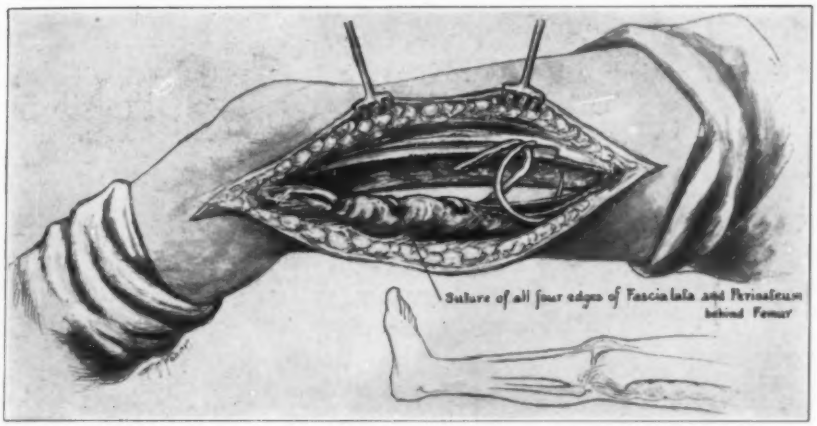

FIG. 4

Shows the formation of the posterior check ligament of the knee.

advantages of a stiff knee. An operation to construct intra-articular check ligaments might be effective, but such ligaments would be subjected to great strain in the leverage of the knee joint. Dr. Willis Campbell has reported good results from an operation whereby he fixes the patella in the tibia in such manner as to make a bone block to hyperextension of the knee. To the author it appeared that the most logical operation would be one which would strengthen or reenforce the posterior structures of the knee which naturally limit hyperextension. He accordingly devised the following procedure and has employed it successfully for two years.

FIG. 5

M. H. Genu recurvatum of right knee.

FIG. 6

M. H. Seventeen months after operation.

DESCRIPTION OF THE OPERATION

An external lateral incision begins just below the head of the fibula and is carried upward to the middle of the thigh. An internal lateral incision extends upward from the internal tuberosity of the tibia to the junction of the middle and lower thirds of the thigh.

The fascia lata is split on both sides in line with the skin incisions. Blunt dissection is then made down to the femur. The periosteum is cut longitudinally along the same lines and is thus divided into a posterior third and an anterior two-thirds. The posterior portion of the periosteum is separated from the femur from above downward until it becomes densely adherent to the bone and blends with the posterior and lateral ligaments of the knee.

With a scalpel the lateral ligaments of the knee are cut longitudinally in the same line with the incisions through the fascia lata and the periosteum. This divides them into a posterior third and an anterior two-thirds, approximately.

FIG. 7
K. A. Genu recurvatum.

FIG. 8
K. A. Two years and four months after operation.

FIG. 9
K. A. Two years and nine months after operation for correction of back-knee.

A sharp osteotome is then used to separate the posterior third of the periosteum and the lateral ligament on each side from the condyle of the femur. The detached portions of the lateral ligaments are also separated subperiosteally from the upper aspect of the tibia but are left attached to it about one-half inch below the line of the knee joint. The upper attachment of the posterior ligament of the knee is also separated from the femur with the periosteum.

When the knee is flexed it is found that these lateral structures tend to fall backward behind the axis of the knee.

FIG. 10

V. K. Six months after operation.

FIG. 11

A. P. Six months after operation.

A long strip of the fascia lata is then cut from its external anterior edge and is left attached at its lower end. It serves as the suture material with which the posterior free edges of periosteum and fascia lata on both sides are all brought together behind the femur as the knee is kept flexed.

The suturing of these structures together behind the femur shortens them and makes a strong posterior check ligament which prevents hyperextension of the knee because it arises from below the knee joint. The degree of extension of the knee which is to be permitted is regulated by the amount of shortening of these posterolateral structures which the surgeon produces. The farther downward he carries the suture, the greater is the shortening.

The popliteal vessels and nerves are at no time in any danger of injury as the entire operation is carried out on a plane anterior to them.

The skin wounds are closed with No. 1 twenty-day chromicized catgut. The extremity is fixed in plaster with the knee slightly flexed.

The knee is protected from the strain of hyperextension for a period of at least three months.

Seven cases have been operated on. One partial relapse occurred in the first patient operated upon. This was probably due to the fact that the sutures through the edges of the periosteum and fascia lata were not carried far enough downward behind the knee. All other patients have expressed great satisfaction with the operation. Their knees are strong and free from pain. They have been able to discard all braces.

CORRECTION OF DROP-FOOT BY THE POSTERIOR ARTHRODESIS

BY ATH. CONTARGYRIS, M.D., ATHENS, GREECE

The different procedures which formerly were employed for the correction of drop-foot have been somewhat disappointing, — as, for instance, the silk ligaments, fascia lata, and tendon implantations or displacements. These are uncertain, as the constant force of gravity results in an elongation of the ligaments. The astragalectomy of Whitman is not applicable to all paralyzed feet. The triple arthrodesis gives disadvantage in walking on irregular ground, and also the difficulty of adjusting an extension shoe when the limb is short.

Because the results are unsatisfactory, particularly in the lack of permanency of the correction, one is inclined to employ for this purpose a posterior arthrodesis. There are four of these methods published today, — the procedures of Toupet, of Campbell, of Camera, and of Nové-Josserand. The procedure published by Nové-Josserand is a modification of the Campbell operation and is, in my opinion, the most simple and most efficient. The technique of this operation was described in *The Journal of Bone and Joint Surgery* in April 1928.

The purpose of the present report is: (1) to give the end results thus far obtained with the posterior "artrorise" of Nové-Josserand and (2) to make a comparative estimation of the four procedures of arthrodesis mentioned above.

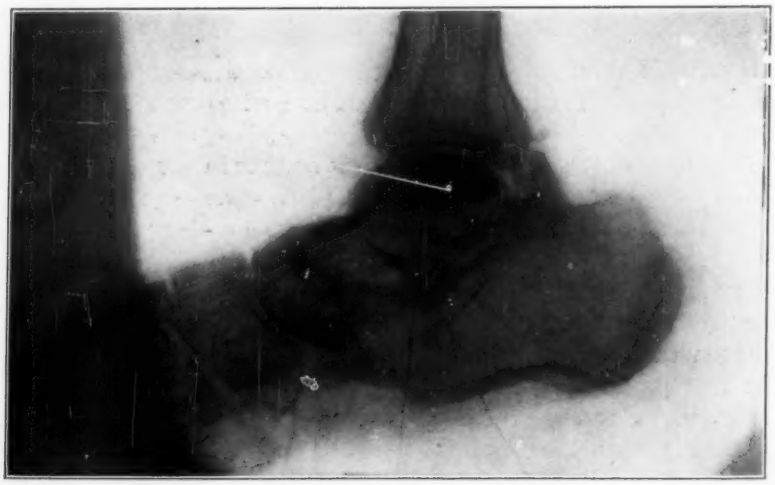

FIG. 1

Bone block for correction of drop-foot. Ten months after the operation.

END RESULTS OBTAINED WITH THE POSTERIOR "ARTRORISE" OF NOVÉ-JOSSERAND

We have employed this procedure in nine cases. Our first operation was done in November 1924 and the last in March 1929.

Poliomyelitis was the etiological factor of drop-foot in five of our cases; severance of the external popliteal nerve in two; spastic paralysis in one case; and one case was an instance of equinus stump following Chopart's operation.

The age of our patients ranged from thirteen to twenty-eight years.

The osseus process obtained by this procedure is well tolerated; it limits the plantar flexion to between 100 and 110 degrees and permits a dorsiflexion of ten to twenty degrees. Fracture or deficiency of the process was not noted in our cases. On the contrary, the process keeps its conformation and in time becomes solid, as illustrated in Figure 2, which shows the process five years and six months after the operation. This fact, which proves that the process subsists, must be attributed, in my opinion, to the pedicle by which it is attached to the os calcis and which assures its proper nourishment.

The end results of this procedure are based upon twenty cases (twelve by Nové-Josserand and eight by the writer), observed from one and one-half to five years after the operation. The writer's series includes nine cases but the first, an equinus stump following a Chopart operation, will not be considered; as it was necessary, in that case, shortly after the operation, to amputate at the inferior third of the leg, owing to an osteitis of the astragalus.

Of the twenty cases, there were eighteen (ninety per cent.) in which the result was excellent and two (ten per cent.) in which it was good. No deficiency in the procedure has been noted in any of the cases, either by

FIG. 2

Same case. Five years and six months after the operation.

Nové-Josserand or by the writer; but in three of Nové-Josserand's cases in trying to formulate the technique of the operation, a fracture of the osseus process resulted. The functional result even in those cases was satisfactory, however, because there had been made in the place of the process a bony mass sufficiently prominent to establish a satisfactory bone block.

I attribute the success of the bone process, in all the cases operated upon according to the method of Nové-Josserand, to the fact that the process is better nourished when attached directly by a pedicle to the os calcis than in cases where the bone process is obtained by free graft (as in the methods of Toupet and Camera), or by a mass of several bone pieces (Campbell).

The probability of persistent postoperative pain from pressure of the new osseus process has been suggested, but experience has proved that there is no danger of such an occurrence. In our cases no patient has complained of postoperative pain as a remote or permanent symptom.

COMPARATIVE ESTIMATION OF THE DIFFERENT PROCEDURES OF POSTERIOR ARTHRODESIS

The procedure of Toupet does not seem to be much employed, for it is known that grafts of dense bone through joints become absorbed and therefore are fractured. Ombrédanne has noted this after the operation of Toupet. Three operations according to this procedure have been published, but only one was actually verified six months after the operation; in this one the result was excellent.

By the first procedure of Campbell 135 operations have been reported with excellent functional results six months after the operations in eighty-four and five-tenths per cent. One excellent result was also obtained with the same procedure by Ollerenshaw.

The second procedure of Campbell has been performed in over 300 cases. The results were excellent in ninety-three and eight-tenths per cent. There were fourteen cases in which the osseus process did not permanently prevent drop-foot, but there were only ten, as demonstrated by the roentgenograms, where the process was apparently defective. I attribute this accident to the fact that the mass of bone pieces which form the bone block is sometimes not properly nourished; so the process is less reliable and at times is in danger of being crushed. This procedure has, moreover, the disadvantage of depriving the foot of the scaphoid, which is indispensable for its good conformation.

The procedure of Camera has been employed by himself in ten cases and by Maragliano in four. Ombrédanne and Rocher tried a similar procedure in a few cases. The results, published some months after the operation, are good, but we should wait for later results in order to ascertain the vitality of the graft.

As for the procedure of Nové-Josserand, it has been tried in twenty cases with excellent end results in ninety per cent. and good end results in ten per cent. The bone process is efficient in all cases.

Of the four procedures of posterior arthrodesis for correction of drop-foot outlined above, the most successful are the procedures of Campbell and of Nové-Josserand. The procedure of Nové-Josserand is preferable, however; it is simpler and more efficient than that of Campbell; though both give good results in about the same proportion.

The procedure of Nové-Josserand has the advantage of assuring always a sufficient bone block, thanks to the pedicle with which it is attached to the os calcis providing for its favorable nourishment. Moreover, the procedure of Nové-Josserand has the advantage of correcting not only the drop-foot, but also the associated lateral inclinations of the foot (varus or valgus) by associating the blocking osseus process with the subastragaloid and mediotarsal arthrodesis, which must be done in all similar cases.

CONCLUSIONS

1. Of all the procedures for correction of drop-foot, the posterior arthrodesis gives the most durable results.
2. The operation of posterior arthrodesis is simple and not dangerous.
3. Good results are obtained with all procedures used for posterior arthrodesis.
4. The posterior "artrorise", according to Nové-Josserand, however, is, in my opinion, preferable to all the others, because it always assures a sufficient bone-blocking process.

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BLOOD SERUM CALCIUM IN RELATION TO THE HEALING OF FRACTURES*

BY KELLOGG SPEED, M.D., CHICAGO, ILLINOIS

Petersen's work and his statement that a blood serum calcium-phosphorus product of thirty or lower leads to non-union after fracture have been generally accepted, liberally quoted, literally interpreted. After studying blood serum calcium and phosphorus in a consecutive series of patients with fracture and failing to find any great degree of abnormality or correlation of the blood serum findings to the clinical course of union or non-union, experimental work was undertaken to test out Petersen's conclusions. After the inception of this work, improved diets for effecting a change in blood calcium and phosphorus were found necessary. When the bone-healing findings failed to conform with Petersen's, other radical

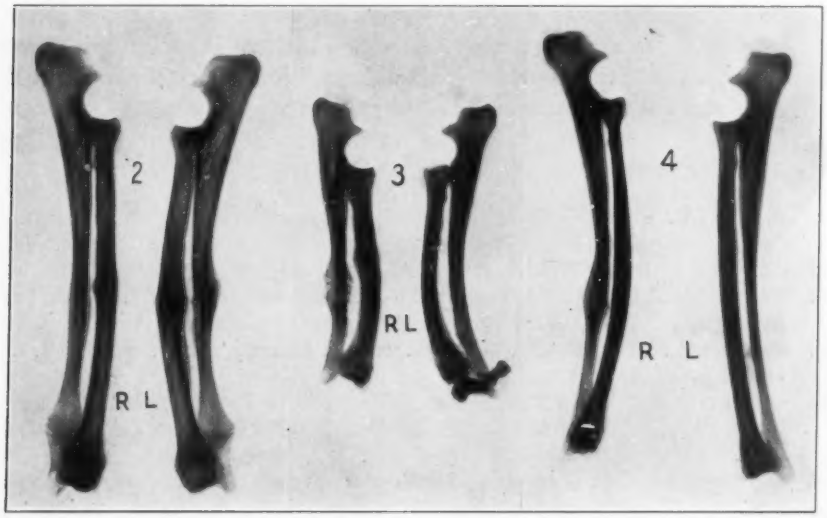

FIG. 1

X-ray on one film of grouped removed bone specimens from experimental dogs. The right leg bones indicated by *R* in each instance have gone six weeks since fracture; the left leg, indicated by *L*, three weeks.

Dog 2. Blood calcium and phosphorus reduced by prolonged dieting.

Dog 3 and Dog 4. Normal control dogs; Dog 4 being a litter mate of Dog 2. There seems to be very little change if any in bone density of these specimens all exposed to the same film at one time. There is likewise little difference in the amount, density, and rapidity of maturation of the various fractures which would seem to eliminate the influence of lowered blood calcium and phosphorus on ordinary bone union after fracture.

*Presented at the Annual Meeting of the American Orthopaedic Association, Chatham, Massachusetts, June 20, 1930.

TABLE I

AVERAGE DOG WITH CALCIUM-PHOSPHORUS PRODUCT REDUCED BY DIET

Dog 1	Serum Ca mg.per 100c.c.	Serum P mg.per 100c.c.	Ca X P Product	Diet	Weight before feeding in Kg.	Condition	Appetite	Faeces	Fracture
1928									
Nov. 7	10.3	6.0	61.8	I	4.5	O. K.	Good	Intense diarrhoea	
Nov. 14	10.3	6.1	62.8	I	4.4	Slight snuff	Average	Very soft	
Nov. 23	10.2	5.7	58.1	I	4.5	Increased snuff	Average	Diarrhoea	
Nov. 30	10.4	5.7	59.2	I	4.5	Better	Average	Diarrhoea	
Dec. 7	10.3	5.8	59.6	I	4.6	O. K.	Average	Diarrhoea	
Dec. 14	10.1	5.4	54.5	II	4.8	Mange and worms	Average	Diarrhoea	
Dec. 20	10.2	5.5	56.1	II	4.8	Mange and worms	Average	Diarrhoea	
Dec. 27	9.9	5.2	51.4	II	4.8	Better	Poor	Diarrhoea	
1929									
Jan. 4	9.4	4.9	46.06	II	4.3	O. K.	Poor	Diarrhoea	
Jan. 10	9.6	4.8	46.08	II	4.4	Slight mange	Poor	Soft	
Jan. 18	9.8	4.7	46.06	II	4.4	Slight mange	Poor	Firm	
Jan. 20	9.5	3.1	29.45	III	4.5	Better	Poor	Firm	
Jan. 29	9.4	2.6	24.4	III	4.5	O. K.	Poor	Firm	Right leg fractured
Feb. 5	9.4	2.8	26.3	III	4.4	O. K.	Poor	Firm	
Feb. 14	9.3	2.8	26.0	III	4.7	Mange	Poor	Soft	
Feb. 21	9.5	2.7	25.6	III	4.8	Better	Poor	Soft	Left leg fractured
Feb. 28	9.4	3.0	28.2	III	4.8	Better	Poor	Soft	
Mar. 6	9.3	2.9	26.9	III	5.0	Infection in jaw	Poor	Firm	
Mar. 12	9.4	3.1	29.14	III	5.1	Mange better	Poor	Firm	Killed and both legs removed

changes in the blood serum relationships of these two salts were attempted and this expansion of the experiments finally led to parathyroidectomy on dogs with its profound effect on their blood serum content of calcium and phosphorus. A broad discussion, of more than one point is consequently forced upon the writer.

Three types of experimental fractures on dogs have been performed.

1. Fractures during a period of low blood phosphorus, little calcium lowering, produced by deficient diet.

2. Fractures during a period of high blood calcium produced by feeding large amounts of calcium lactate three times a day.

3. Fractures during a period of low blood calcium produced by parathyroidectomy. This brought about in time a high blood phosphorus.

In Table I are shown the blood findings of one of the animals in the first series of experiments. All dogs in this series conformed to these figures. These animals failed to give clinical evidence of delay in bony union after experimental fracture when compared to a normal (and often

TABLE II

AVERAGE DOG WITH HYPERCALCAEMIA AND LOWERED SERUM PHOSPHORUS

Dog 23	Serum Ca per 100c.c.	Serum P per 100c.c.	Ca X P Product	Diet	Weight in Kg.	Condition	Appetite	Faeces	Fracture
1929									
Mar. 3	10.6	6.4	67.89	Normal	5.1	Good	Good	Firm	
Mar. 10	10.5	6.5	68.25	IV	4.8	Good	Fair	Firm	
Mar. 19	9.9	5.8	57.42	IV	4.0	Good	Poor	Firm	
Mar. 29	9.8	5.3	51.94	IV	3.7	Good	Poor	Firm	
Apr. 4	9.3	4.8	44.64	IV	3.5	Good	Poor	Firm	
Apr. 11	9.9	4.9	48.51	IV	2.9	Good	Poor	Firm	
Apr. 17							Fair	Firm	
Apr. 25	9.5	3.9	37.05	IV	3.2	Good	Fair	Firm	
May 2					3.6	Good	Fair	Firm	
May 8	9.3	3.1	28.83	IV	3.4	Good	Poor	Firm	
May 11									Right leg fractured
May 15	14.1	3.2	45.12	IV	3.5	Good	Poor	Firm	
May 22	14.5	3.2	46.40	IV	3.3	Good	Poor	Firm	
May 29	14.8	3.1	45.88	IV	3.4	Good	Poor	Firm	
June 1									Left leg fractured
June 7	15.4	3.0	46.20	IV	3.3	Good	Poor	Firm	
June 14	15.3	2.9	44.37	IV	3.4	Good	Poor	Firm	
June 21	15.6	3.0	46.80	IV	3.5	Good	Poor	Firm	
June 22									Killed. Legs removed

litter mate) control. The x-ray findings were likewise equivalent to the normal, and the microscopic findings were those of normal bone healing.

In the second series of experiments the blood findings of hypercalcaemia in the typical animal are shown in Table II.

The phosphorus was first reduced in this series of dogs by feeding Diet IV. When it reached a low level, the fractures were made (May 11, 1929). Originally the idea was to produce a hypercalcaemia in the presence of a low phosphorus by the administration of calcium lactate reenforced by injections of parathormone.

For the first seven days after fracture three daily doses of calcium lactate (2 Gm. per Kg. in each dose) were given by stomach tube, morning, noon, and night. Around 9:30 p.m. injections of parathormone were given (1 to 1.5 c.c.,—1 c.c. containing 20 units). It was found necessary to use this amount to elevate the calcium level one to two milligrams. The disadvantage following the use of the parathormone was that the phosphorus also was raised. Collip has also noted this fact. Since it was wished to keep the phosphorus content down, the hypercalcaemia was therefore maintained solely by the administration of lactate from May 19 on. (Test period for parathormone May 11—May 19, 1929.) This insured a high level during the day which fell gradually through the night, the morning blood calcium level being around the normal amount.

These animals failed to show any clinical delay or acceleration of bone healing after experimental fracture, when compared to the normal (and

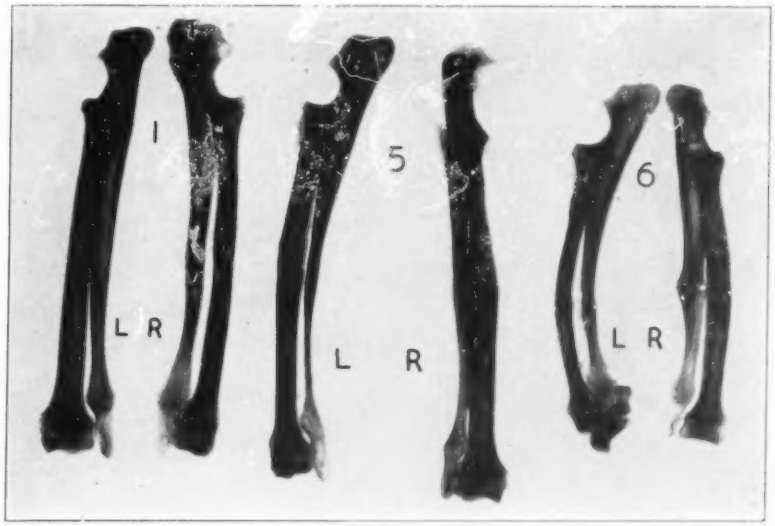

FIG. 2

Additional evidence similar to that shown in Fig. 1. This is an x-ray film of grouped bone specimens from experimental dogs. The right leg bones, indicated by *R*, have gone six weeks since fracture; the left leg bones, indicated by *L*, three weeks.

Dog 1. Blood calcium and phosphorus reduced by prolonged dieting.

Dog 5 and Dog 6. Normal control dogs. No delay or untoward findings in bone healing are evidenced in the bones of the diet-reduced dog.

TABLE III

AVERAGE DOG—THYROPARATHYROIDECTOMY AND BLOOD CHANGES

Dog A	Serum Ca per 100c.c.	Serum P per 100c.c.	Ca X P Product	Diet	Weight in Kg.	Condition	Appetite	Faeces	Fracture
1929									
Apr. 16	10.2	3.8	38.76	Normal	13.6	Good	Good	Firm	
Apr. 17	Thyroparathyroidectomy								
Apr. 23	6.3	5.8	36.54	Normal	14.0	Fair	Poor	Diarrhoea	
May 10	7.0	5.9	41.30	Normal	14.5	Good	Fair	Firm	
May 23	6.9	7.0	48.30	Normal	15.0	Fair	Poor	Diarrhoea	
June 1	6.3	7.4	46.62	Normal	15.2	Fair	Poor	Diarrhoea	Right leg fractured
June 14	6.5	7.8	50.70	Normal	14.5	Good	Fair	Soft	
June 20									Left leg fractured
June 26	6.8	7.8	53.04	Normal	13.9	Good	Good	Soft	
July 4	6.5	8.2	53.30	Normal	12.8	Fair	Good	Firm	
July 11	6.1	10.0	61.00	Normal	11.9	Fair	Good	Firm	
July 12	6.1	9.4	57.34	Normal					Killed. Legs removed.

Dog given 1½ Gm. of calcium lactate per Kg. of weight daily and 1½ Gm. of thyroid extract daily after thyroparathyroidectomy.

TABLE IV

BLOOD SERUM FINDINGS IN FRACTURE PATIENTS

Average of ten patients who had	Serum Ca mg. per 100 c. c.	Serum P mg. per 100 c. c.	Ca × P Product
Non-union after fracture	10.64	3.53	38.19
Normally healing fracture	10.16	3.87	39.26

Diet I—McCollum—(*Johns Hopkins Bull.* XXXV, 379, Nov. 1924)

White bread	200 Gm.	
Milk (skimmed)	100 c. c.	
Liver	10 Gm.	per Kg. of body weight.
NaCL	1 Gm.	
$CaCO_3$	0.3 Gm.	

Diet II—McCollum—(*Johns Hopkins Bull.* XXXV, 379, Nov. 1924)

Rolled oats	40%
Gelatin	10%
Wheat gluten	17%
$CaCO_3$	3%
White flour	36%
Butter	2%
Orange juice	5 c. c.
NaCL	1%

Diet III—Steenbock (J. Biol. Chem. LVIII, 386, 1923-1924) for each dog.

Equal parts—
Rolled oats
White corn meal
} autoclaved at 151 lbs. for one hour.

5 Gm. casein
2 Gm. NaCL
5 Gm. Dicalcium phosphate
200 c. c. skimmed milk autoclaved at 151 lbs. for one hour.

Diet IV—Normal Diet. Each dog *ad libitum*.

Boiled lungs or heart and lung mixture, bread, carrots (raw once or twice a week), 3 Gms. $CaCO_3$. Top of bottle.

often litter mate) control. The x-ray findings were likewise equivalent to those of the normal dog after fracture, and the microscopic findings were those of normal bone healing.

In the third series of experiments the blood findings of the typical animal after thyroparathyroidectomy are shown in Table III. These animals showed clinically a decided delay in bone healing after experimental fracture when compared to the normal (and often litter mate) control. The x-ray and microscopic findings of the removed bones confirmed this delay in bone healing.

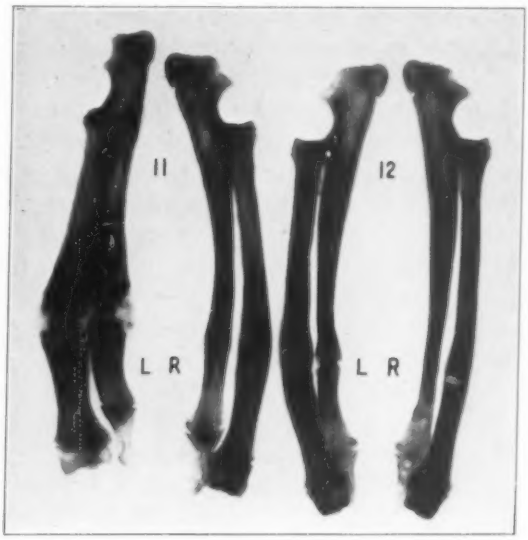

FIG. 3

Bones of experimental Dog 11 and Dog 12 obtained after similar conditions of time after fracture and marked as in the previous figures.

Dog. 11. Blood calcium and phosphorus reduced by diet.

Dog 12. Normal control, litter mate. There are no apparent x-ray findings to indicate that lowered blood phosphorus and calcium changed bony healing.

The results of several hundred blood determinations on fracture patients seem to show that:

1. Immediately after fracture the blood phosphorus is low.
2. The blood calcium is normal.
3. The average admission calcium-phosphorus product is within normal limits,—thirty-six to forty.
4. Within twenty-four hours after any major fracture the blood serum phosphorus content rises and remains high, coming down slowly, possibly varying with the period of disability,—three to five weeks. Increased muscular exercise may hasten this.
5. The blood serum calcium content remains about stationary.
6. Diet has little or no effect on either calcium or phosphorus content of the peripheral blood.
7. After any operative procedure there is an almost immediate rise in blood serum phosphorus followed by a rapid fall to normal.

The following comment on the experiments and the value of blood serum calcium-phosphorus determination in patients with fracture seems justified:

In healthy dogs reduction of blood serum calcium and phosphorus or elevation of blood serum calcium and reduction of phosphorus have no consistently demonstrable effect on the healing of experimental fracture, even after a considerable period of time or with a reduction which gives a

numerical product of less than thirty, amounts of each per 100 cubic centimeters of blood serum being taken.

After thyroparathyroidectomy, however, with resulting lowering of blood serum calcium and raising of blood serum phosphorus, even when the product does not get anywhere near as low as thirty, there is great delay in bony union after experimental fracture in dogs. It is possible that the lack of parathyroid hormone may be responsible for this delay. On the other hand, in long existing tumors of the parathyroids,—such as adenoma with hyperparathyroidism—a softening of the bones comparable to osteomalacia may result clinically. In cases of this nature reported in the literature the blood serum calcium was generally high, the phosphorus low, and the calcium-phosphorus product was in the majority of instances over thirty.

Taking average humans suffering fracture, it seems then impossible to prognosticate delayed or non-union after fracture by any estimation of blood serum phosphorus-calcium content or their numerical product. Estimations made on several hundred consecutive patients with fracture show a normal range of calcium and phosphorus in the blood serum, although some of these patients went on to delayed union and non-union. (See Table IV.)

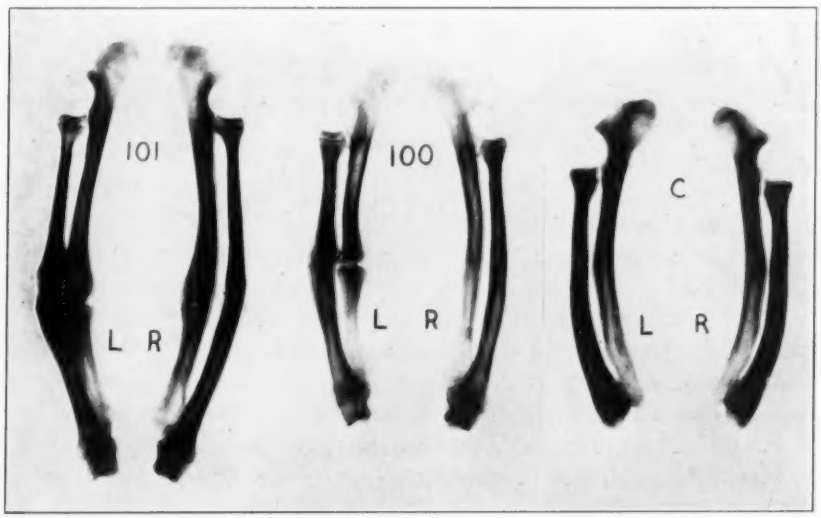

FIG. 4

X-ray of grouped removed bone specimens from experimental dogs. In each instance the right leg has gone six weeks, the left leg three weeks since fracture.

Dog 101 had a high blood calcium content and a low phosphorus. See table.

Dog 100 had similar high calcium and low phosphorus.

Dog C. This dog survived thyroparathyroidectomy for several weeks but the legs were never fractured. There was a low blood calcium and a high phosphorus present. Comparison of these bones exposed on the same plate shows little difference in density although there was wide variation of blood calcium and phosphorus. Likewise the bones of Dog 100 and Dog 101 seemed to have healed in a normal period of time with a conventional amount of callus. No demonstrable gross changes were found which would identify the changes in blood serum.

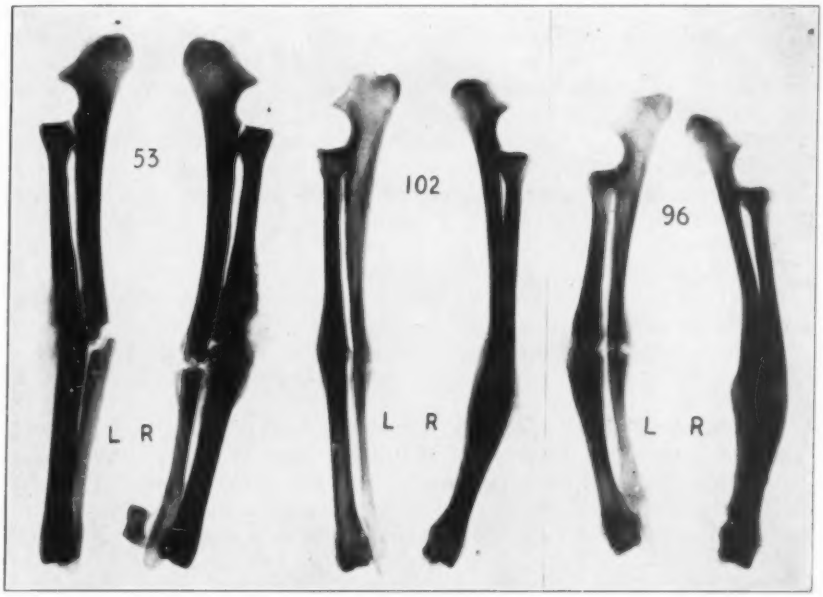

FIG. 5

X-ray film of grouped removed bone specimens similarly arranged as in the previous figures. All right legs had gone six weeks, all left legs three weeks since fracture.

Dog 53. This animal had undergone thyroparathyroidectomy, followed by experimental fracture of both legs. See article on Experimental Healing of Bone after Parathyroidectomy. Speed and Rider, Arch. Surg., XXI, 679, Oct. 1930.

Dog 102 had high blood serum calcium and low phosphorus. See table.

Dog 96 was a normal control litter mate.

The bones of Dog 53 after thyroparathyroidectomy show evidence of delayed union at the fracture site, but have considerable subperiosteal callus extending up the shafts of the bones. The other two dogs show an average rate of healing and callus formation—although there was marked variation in the blood serum findings. In the x-ray examination the parathyroidectomized bones do not appear to show any loss of calcium as compared to the normal or the hypercalcaemic specimen.

Ordinary dietetic methods or the administration of calcium salts appear not to affect the rate of flow of calcium away from or into the bones to guarantee the surety of the bone-healing process after fracture. It is believed, consequently, in the light of these experiments and the observation on many humans, that an estimation of blood serum calcium and phosphorus is valueless from a prognostic standpoint; that attempts to change the blood serum content of these two elements is valueless as a sure means of obtaining union after fracture, and that no numerical product of the two elements, gauged by the amount of them present per 100 cubic centimeters of blood serum can be used as a criterion of prognosis.

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THE INFLUENCE OF ALTERATIONS IN THE CIRCULATION ON THE REPAIR OF BONE*

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The primary function of the circulation is to supply the physiological needs of tissue maintenance and growth. During the repair process after injury, regenerative activity is at a maximum and there are corresponding demands upon the vascular supply. Alterations in the circulation during the reparative process will, therefore, exert their influence on the rate and character of healing of the tissues supplied.

An opportunity to study the growth process under conditions of abnormal blood supply is afforded in the rate of healing, and for this purpose serial roentgenograms of bone form a convenient method. Such a study of the influence of changes in the circulation on the healing of bone gives information, not only about the general processes of tissue growth, but also concerning some of the factors which may enter into the healing of bone lesions in the clinical care of patients. This latter phase of the subject is interesting because of the many abnormal circulatory manifestations,—such as cyanosis, ecchymosis, rubor, and oedema—which may accompany bone lesions. Further, the treatment of the injury may introduce added factors of vascular change from prolonged immobilization, the pressure of casts or splints, or from physiotherapy. Thus it becomes of interest, to those who care for patients with bone disorders, to know of the circulatory factors influencing osteogenesis in order that rational therapy may be used.

A study of the effect of alterations in the blood supply on bone growth was undertaken and has been carried on to the point of observing the effect of changes in the venous, the arterial, and the vasomotor systems on the healing process. The results of some of the experiments on the venous system have been reported [2, 3]. In the article dealing with the effect of obstruction of the deep veins coming from the bone on the osteogenetic process, a historical review of the subject was given[3]. It has been brought out that venous stasis accelerates bone growth, and of this there is no doubt; for the phenomena have been observed in pathological states, in clinical cases of delayed union of fractures, and in controlled experiments. The results of blocking the deep venous system have been quite consistent; so that we

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feel that we have produced the first clear-cut experimental proof that venous stasis accelerates callus production, causes more rapid calcification and resorption of callus, and brings about quicker healing of bone.

We have continued our experiments on other circulatory factors which might influence the osteogenetic process and wish to record the results of blockage of the lesser saphenous vein, of excision of the femoral artery, and of lumbar sympathectomy on the repair process in resections of the fibula.

METHOD

Dogs were the test animals used. Under ether anaesthesia and using surgical asepsis an equal-sized segment of bone was removed subperiosteally at a measured distance from the head of the fibula on each side. The left side served as the control and the right side was used to observe effects on the repair after making alterations in the circulation of that side. Careful dissections were made to determine the peculiarities of the vascular system in the dog. It was found (Fig. 1) that there is a deep venous system through the popliteal vein; and two large superficial veins, the saphenous and the lesser saphenous, which unite in a loop in the lower leg and collect the superficial venous blood. In some of our earlier experiments the great saphenous vein was tied[2]; a saw was used to remove the bone fragments, and the great importance of preserving the periosteal bridge was not recognized. Consequently it may be necessary to reconsider our opinion that blocking the saphenous vein may lead to non-union. Additional tests on both the saphenous and lesser saphenous veins are being conducted and we prefer to reserve our opinion for the present. We now use a Hibbs' spinous process rongeur which gives a sharply cut bone end with no bone dust; and we are very particular about the periosteum, discarding all ani-

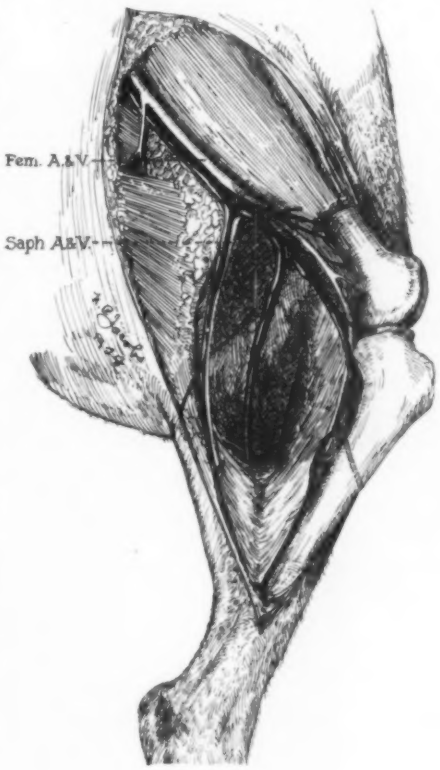
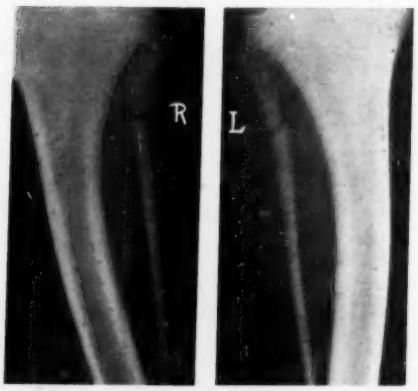


FIG. 1

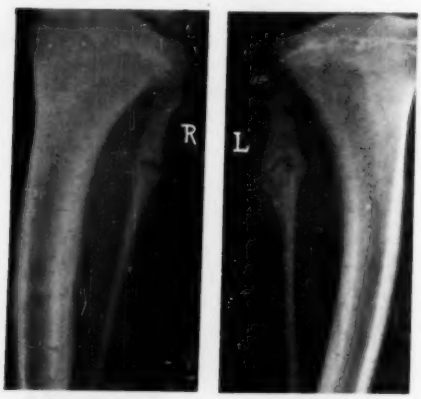
Schematic drawing showing the arrangement of the vessels of the dog's hind limb. The femoral vein is formed by the confluence (at *b*) of the popliteal vein which drains the deep structures and the superficial lesser saphenous vein. At a proximal point (*a*) it is joined by the saphenous vein.

The right side from which the femoral artery was resected.

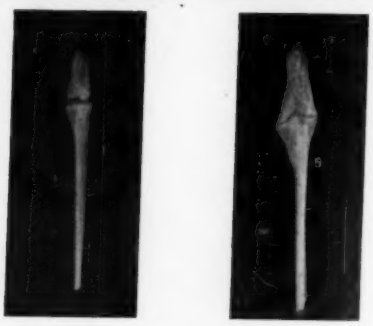
The left or control side.



March 17, 1930. The amount of bone resected.



April 17, 1930. Healing on the right side is delayed.



April 19, 1930. The final result; the normal healing is nearing completion.

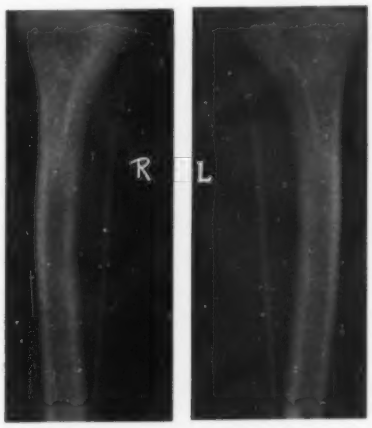
FIG. 2

Shows the average result of retardation of bone healing subsequent to the removal of the arterial tree.

The right side from which the femoral artery was resected.

The left or control side.

March 17, 1930. The amount of bone resected.



April 17, 1930. There is no evidence of healing on the right.

April 19, 1930. Non-union on the right while the normal side is nearly healed.

FIG. 3

Shows the extreme result of retardation of bone healing with non-union subsequent to the removal of the arterial tree.

mals in which the periosteum is frayed or shredded. This is important, not only because of its own possible function in bone repair, but also to prevent muscle fibers from slipping in between the bone ends. It also serves to keep the alignment good. This technique has been standardized so that the experimental method remains constant, while the circulatory alteration to be studied becomes the variable factor.

RESULTS

Small saphenous vein. The effect of obstruction of the lesser saphenous vein on the repair of the fibula of that side was observed in eight experiments. There was no observable difference in the rate of repair of the resected fibula on this side when compared with the opposite control limb. This is rather surprising because the lesser saphenous vein of the dog is quite large, being second in size only to the femoral vein in the leg. However, it has been mentioned that the two saphenous veins anastomose freely with one another by means of venous loops and any obstruction of the circulation of one will probably be cared for by the other. It would seem that to obtain a maximum effect the entire superficial circulation, including both saphenous veins, must be obstructed. This is to be tried in the near future.

Resection of the femoral artery and its terminal branches. It was desired to study the effect of relative local anaemia on the healing process of bone. The first step in this direction was the ligation and division of the main artery, the femoral. Experiments in which this was done revealed no observable effect on the osteogenetic process. Injection of the arteries with opaque radiographic solutions showed a rapid development of collateral circulation. It has been shown[4] that it is possible to dissect out the femoral artery and its terminal branches with only occasional loss of viability of the limb. It was believed that this radical excision of the arterial tree should result in a lower vascular supply to the point of bone healing. Consequently ten dogs were operated upon with removal of the right femoral artery from Poupart's ligament to and including the terminal vessels in the calf, and the effect on the repair of the resected fibula observed.

There is always some transient soreness and swelling after this procedure probably accounted for by the extensive dissection, but this subsides in two or three days after operation. The animal then walks upon the limb without apparent discomfort. The result of this removal of the femoral artery on the behavior of the collateral channels has been reported previously[4]. It is sufficient to state that the collateral vessels dilate sufficiently for maintenance of viability of the limb.

Six of the animals showed unmistakably diminished callus and delayed union of the fibula on the side of excision of the artery, and one of these developed non-union (Figs. 2 and 3).

Three animals showed slight or questionable retardation of healing on the right side but the difference from the left, control side, was not marked.

One dog developed gangrene of the limb two days after operation and was sacrificed.

Thus it would appear that in all of the animals which were allowed to survive, the healing of the fibula on the side having the artery resected was to a greater or lesser extent retarded. From these results we conclude that local arterial anaemia results in slowing of the osteogenetic process.

Lumbar sympathectomy. Reports in the literature [1, 5] seem to indicate that the sympathetic nervous system may have some influence on bone repair, and periarterial sympathectomy has been advocated for the treatment of delayed or non-union of fractures. The indications for this procedure are based on the effect in producing arterial hyperaemia by removing the vasoconstrictor influence. Resection of the lumbar sympathetic ganglia and trunk has the same type of action. Clinical experience with these procedures has shown that a more pronounced effect may be expected from lumbar ganglionectomy than from periarterial sympathectomy. Since in the experiments the maximum effect of arterial hyperaemia was desired, it was decided to perform resection of the lumbar sympathetic trunk and ganglia to study the result on bone repair.

Ten dogs were subjected to a right lumbar sympathectomy after a portion of both fibulae had been removed. The sympathetic trunk was excised by a transperitoneal approach from the right renal vein to the promontory of the sacrum, all communicating rami being severed. The results of these experiments showed that the rate of callus formation and healing on the sympathectomized side did not deviate from the normal in seven of the ten animals. In the three remaining dogs the sympathectomy resulted in a demonstrable increase in the rate of bone repair, but this result was not particularly striking. The animals were tested for changes in the temperature of the limbs and a consistent elevation of the temperature of the sympathectomized extremity was found.

From these experiments the conclusion is drawn that if the sympathetic nervous system has any effect on osteogenesis, it is a very slight one.

DISCUSSION

It is of interest to note how the experiments in dogs correlate with the clinical observations in man that a deficient arterial blood supply delays bone growth. Of course it is obvious that the experimental conditions of total excision of the femoral artery would never be encountered in man. But this experimental method illustrates the necessity of an adequate arterial blood supply for progress of proper healing. Pathological states of bone have been explained on the basis of a poor arterial supply to the part, examples of which are Legg's disease, Kümmell's disease, and the frequent non-union of fractures of the neck of the femur and base of the fifth metatarsal. These facts, combined with the experimental demonstration, serve to remind us that in operative procedures on bone it is the part of wisdom to preserve the integrity of the arterial blood supply. Failure to

do this may jeopardize the success of the result by delaying the ossification process.

Little need be said of the phase of the subject dealing with the operations on the sympathetic nerves. In the past, sympathectomy has been advocated for the treatment of ununited fractures. This method has never gained wide use nor has it maintained enthusiastic supporters. The results of the experiments recorded, while they cannot be interpreted directly to apply to the treatment of ununited fractures by sympathectomy, yet serve to strengthen the feeling of skepticism regarding this type of therapy. Fontaine's[1] experiments on dogs were performed on the metatarsal bones and his results might be thus explained on the more pronounced peripheral effects of sympathectomy.

From a purely biological point of view it is interesting to see how little effect arterial hyperaemia has on bone repair.

SUMMARY

Previous work has shown that blocking the deep veins to produce venous stasis at the site of healing results in an increased callus formation and accelerated bone repair. This is a useful procedure in treating delayed union of fractures.

Obstruction of the lesser saphenous vein has no influence on the healing of the fibula.

Blocking the arterial circulation by ligation of the main trunk has no effect because of the rapid development of collateral circulation. When the main artery and its branches are removed, there is delay in bone repair but healing eventually takes place.

Removal of the lumbar sympathetic trunk and ganglia makes very little change in the process of bone repair in the extremity.

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DIAGNOSIS, PATHOLOGY, AND TREATMENT OF FRACTURES OF THE OS CALCIS*

BY DOCENT DR. LORENZ BÖHLER, VIENNA, AUSTRIA

I greatly appreciate the opportunity to demonstrate to this Society my treatment of fractures, especially in Boston, because Boston has been preeminent in this subject for the last fifty years. In the earlier days, accident and minor surgery were in most places not considered important. It seems to me that this opinion is now changing, since there are now so many accidents and the insurance companies pay compensation in these cases.

This is not my first visit to America. In 1914 I was here for a few months, working at the Mayo Clinic in Rochester to learn general surgery; I was not interested at that time in orthopaedic surgery and fractures. When I returned home the War was on. While in Galizia, I could see that in the rapidly changing theater of war in Russia, surgery of the brain and abdomen was not possible, because of the necessary long transportation,—sometimes three or four hundred miles—and all of these patients died during the first day or two. But it was evident that the transportation of patients with fractures or other injuries of the limbs was the most important thing. I made suggestions for the care of these patients, one of which was to obtain some means of good fixation for the fractures. The second year, when in Italy, we were longer in one place and there I had the opportunity to treat many groups of fractures, and in the winter of 1915–1916 made about 300 anatomical preparations of different fractures of the limbs. In 1916 I founded, about twenty miles behind the front, a hospital with 200 beds for fractures alone.

When the War was finished I came to Vienna and there met the registrars of the insurance companies for workmen and saw all the statistics of these companies. The first of these companies had been founded in 1888, thirty years before. The results were not good; for example, fractures of the femur had a permanent disability in ninety per cent. of the cases, fractures of the leg in eighty per cent., fractures of the humerus in sixty-six per cent., and fractures of the forearm in sixty-two per cent. I gave it as my opinion that with their organization it would be possible, by other methods of treatment, to change these statistics completely. Since then an accident hospital has been founded in Vienna; this hospital is now five years old. I am presenting, now, the methods of treatment of fractures of the os calcis which we have developed in this hospital.

*Presented by invitation at the Annual Meeting of the American Orthopaedic Association, Chatham, Massachusetts, June 1930.

DIAGNOSIS AND PATHOLOGY*

Fractures of the os calcis are among the most difficult, from the viewpoint of treatment and end results. From the various reports in the literature and from personal experience, I find that they often remain unrecognized although recognition is easy. The history of a vertical fall upon the heel from a height of one to five meters or more suggests such a condition. Other diagnostic signs are the inability of weight-bearing, the broadening and swelling of the region about the heel, and the hematoma which extends towards the sole of the foot,—a sign never seen in malleolar fractures. The most important sign, however, is the pressure pain, strictly limited to the os calcis.

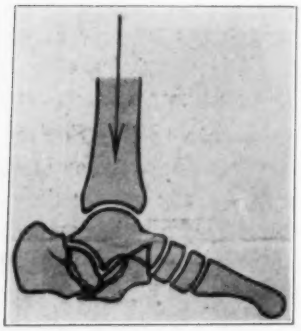

FIG. 1

The impact of the falling body smashes the underlying os calcis with the lateral cuneiform portion of the astragalus.

FIG. 2

View of the fractured os calcis from behind. The outer wall is fractured off. On the inner side the sustentaculum tali is broken off with a portion of the posterior joint surface.

In a vertical fall, the impact of the falling body is transmitted through the tibia to the astragalus and the latter is driven with its lateral, cuneiform portion into the os calcis, which, in the fall, comes first in contact with the ground and there remains. In explosions occurring on shipboard, for example, one sees the same effect produced by a sudden impact from below.

FIG. 3

Drawing of the fractured os calcis seen from the side (after Malgaigne). The tuber-joint angle is negative; the lateral portion of the posterior articular surface is driven downward; the lateral wall is forced outward.

The fracture of the os calcis occurs in a rather typical manner. The lateral wall is broken off, while on the medial side the posterior portion of the surface articulating with the astragalus is shorn off, and is sometimes driven downward. In this manner two fractures are produced in the sagittal plane: one involves the lateral wall of the bone, the other runs from medial side obliquely forward. The medial fragment, containing the sustentaculum tali, usually remains in place; while the middle portion of the bone and the lateral fragment are displaced laterally and appear as a hard bony mass

*The remainder of this paper was translated from the German by A. Steindler, M.D., Iowa City, Iowa.

below the lateral malleolus (Figs. 2 and 4). Occasionally the tuberosity of the os calcis also is divided into several longitudinal fragments. The os calcis appears thereby greatly broadened and shortened. While its width in the axial x-ray picture is normally thirty to thirty-five millimeters, it may, when fractured, attain a width of from forty to seventy millimeters (Fig. 2).

In the lateral x-ray one sees several fracture lines in frontal or oblique planes, which are produced principally by bending or sheering (compression) stress (Figs. 1 and 3). The os calcis appears fragmented in numerous pieces, the tuberosity is stripped off and pulled upward, at times also inward. The more severe the fragmentation, the farther is the tuberosity pulled upward and the greater is the broadening of the bone.

FIG. 4

Drawing of os calcis from above (after Malgaigne). The os calcis shows two large sagittal fracture planes; the lateral portion of the posterior joint face is driven downward; the lateral wall bulges out.

Normally there exists, between the upper contour of the tuberosity of the os calcis and the line uniting the highest point of the anterior process with the highest point of the posterior articular surface, an angle of thirty to thirty-five degrees (Fig. 5). This angle I have named the "tuber-joint angle". In fractures of the os calcis this angle becomes smaller, straight, or even reversed (Figs. 1, 6, 7, and 8), and this displacement is maintained by muscle pull (Figs. 9-A and 9-B).

TREATMENT

The reposition aims at correction of the axial deviation, of the flattening, and of the shortening of the bone. Following this, correction is maintained in proper position, with the aid of a plaster dressing and two pins.

Whereas all other fractures are reduced immediately, in fractures of the os calcis we wait for six to ten days, until the swelling has disappeared. The reduction is carried out under lumbar anaesthesia. The following equipment is necessary:

1. A screw extension apparatus (Fig. 10).
2. Two pins of rustless steel, five millimeters thick, each with a corresponding stirrup clamp so constructed as to be freely movable after engaging the ends of the pin (Fig. 14.).
3. A vise with clamps for the os calcis (Fig. 11).
4. A spring balance.
5. A Braun's splint.
6. Four plaster bandages four meters long, fifteen centimeters wide, weighing 400 grams each.
7. A muslin bandage, ten meters long and twelve centimeters wide.

8. Four sterile sponges (nicked), size four by four centimeters.
9. Tincture of iodin.
10. Balsam of Peru.
11. Mastisol.
12. A silver nitrate stick.
13. Fresh one per cent. solution of novocain for spinal anaesthesia, with suitable syringes and needles.

As soon as the anaesthesia of the limb is complete, the swelling is removed by pressure massage. Then the impaction of the fragments is released by placing the sole over a wooden wedge and forcing the foot into strong plantar flexion (Fig. 12). In case the tuberosity is not loosened sufficiently by this manoeuver, it is then gripped in the vise and moved to

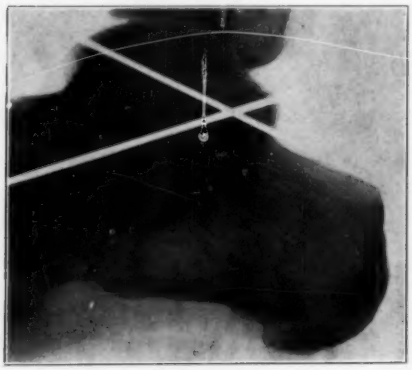

FIG. 5

Normal tuber-joint angle of 40 degrees in a normal os calcis. The longitudinal axis of the astragalus is inclined.

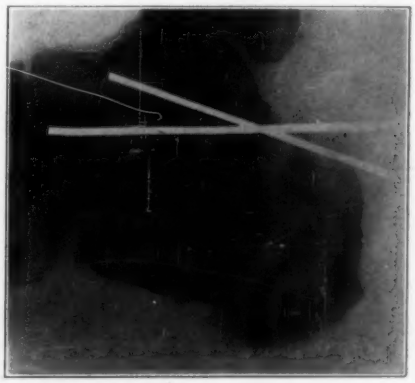

FIG. 6

Tuber-joint angle of 20 degrees in a mild fracture of the os calcis. The longitudinal axis of the astragalus approaches the horizontal.

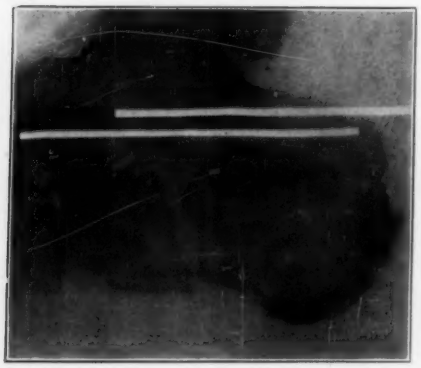

FIG. 7

Tuber-joint angle zero in a severe fracture of the os calcis. The tuberosity is displaced upward so far that the tuberosity line stands higher than the joint line. The longitudinal axis of the astragalus is almost horizontal.

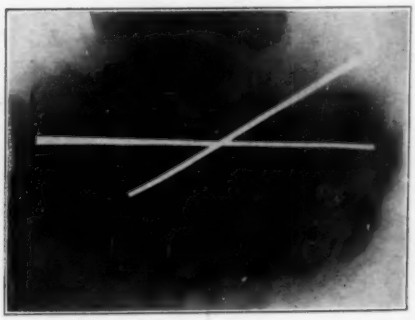

FIG. 8

Negative tuber-joint angle of 32 degrees in a severe, infected fracture of the os calcis. Marked bone atrophy. The longitudinal axis of the astragalus is horizontal.

and fro (Fig. 11). The points through which the pins are to be driven are then marked on the moistened skin with the silver nitrate stick. These marked points appear as white spots after painting the skin with tincture of iodin, by formation of silver iodid. After the skin of the foot and leg has been painted, one pin is placed through the tibia four finger-widths above the ankle joint; the other pin is placed parallel to the former, through the posterior upper corner of the tuberosity of the os calcis, the pins being driven through with hammer or drill (Fig. 13). The skin wounds are covered with the nicked sponges moistened with balsam of Peru. Before the pin is driven through the posterior upper corner of the os calcis, it is necessary to place the foot in maximum dorsiflexion in order to relax the skin, which easily tears unless this precaution is taken.

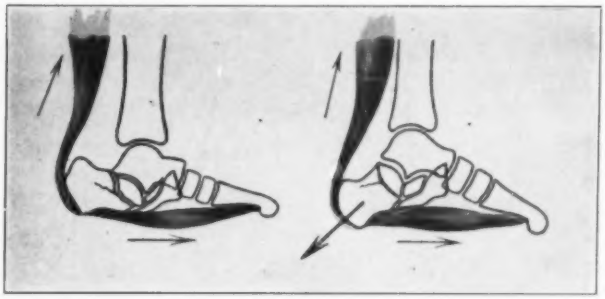

FIG. 9-A FIG. 9-B

Fig. 9-A. Fracture of the os calcis. The muscles of the tendo Achillis pull the posterior fragment upward, thereby causing an axial kinking. The plantar muscles pull the fragment forward, thereby causing shortening and broadening.

Fig. 9-B. The calf and sole muscle action represented by a parallelogram of forces. Their combined action can only be neutralized by a force acting in a direction opposite to that of the resultant of the two muscle forces.

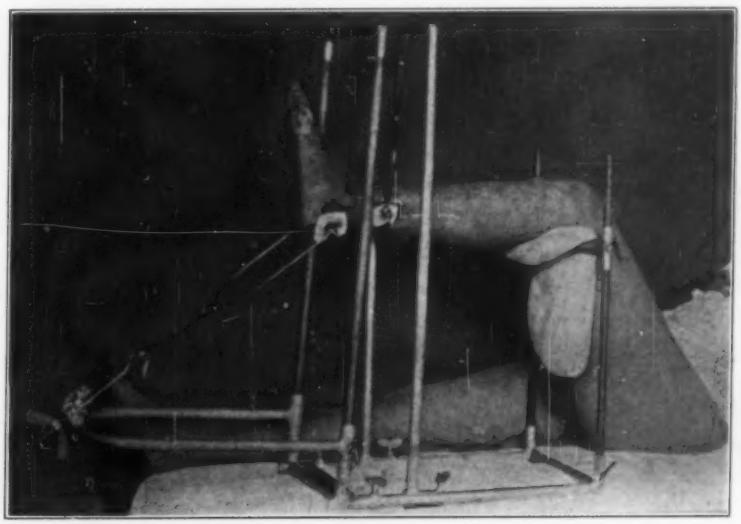

FIG. 10

Arrangement of the screw traction apparatus for the reduction of fractures of the os calcis. A pin is driven through the tibia above the ankle joint, holding the leg. Another pin is driven through the posterior upper edge of the os calcis. On this pin the traction in the axis of the bone is applied.

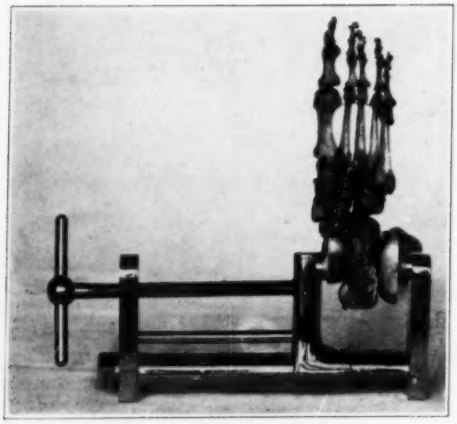

FIG. 11
Os calcis clamped in the screw vise.

Both pins are now engaged in the freely turning wire stirrups (Fig. 14). The free movement of the latter is essential since subsequent traction is to occur in two directions.* This free movement is provided by making the stirrup move freely over a sleeve against which the pins are clamped by set screws.* If on the other hand the stirrup loop were tight against the pin, a traction in different directions would only be possible by turning the pin in the bone, a fact which would be very conducive to drill-hole infection.

Now the limb is placed upon the screw extension apparatus with the knee in flexion. The pin placed above the ankle joint is suspended on its stirrup so as to make the leg horizontal. The right-angle flexion of the knee relaxes the tendo Achillis (Fig. 15). The pin through the os calcis is attached to the hook of the screw extension apparatus after interposition of a spring balance. Then traction is applied,—first in the long axis of the leg to the amount of fifteen to twenty kilograms, in order to pull the tuberosity of the os calcis downward and to restore the tuber-joint angle; the forefoot at the same time being placed in pronation and maximum plantar flexion (Fig. 10). The screw is then lowered and traction of fifteen to twenty kilograms is made in the direction of the axis of the os calcis, in order to overcome the shortening of the bone and the axial deviation in the transverse plane, the forefoot again being plantar flexed and pronated (Fig. 10). The screw and stirrup are again raised and horizontal traction of ten to twelve kilograms in the axis of the leg is applied. By means of this longitudinal traction in the axis of the os calcis and the subsequent traction in the axis of the tibia, as well as by means of the plantar flexion and pronation of the forefoot, the axial kinking, the shortening, and also a part of the broadening of the os calcis

FIG. 12
Plantar flexion of the foot over a wooden wedge in order to mobilize the tuberosity of the os calcis.

*Added by Translator.—*A. S.*

are corrected. The astragalus is lifted off the os calcis and the joint space between the two bones is again restored (Figs. 19 and 21).

In order to correct the remaining broadening the screw vise (Fig. 11) is applied under constant longitudinal traction in such a manner as to place the straight pad on the outside, the concave on the inside below the sustentaculum tali; then the vise is screwed together until a distance of thirty-five to fifty millimeters is obtained. The proper distance for each case is determined by applying the vise first tightly to the sound heel and by reading off the breadth of the os calcis. On the affected side the compression is then carried to five millimeters beyond the normal amount. The vise is released rapidly so as to avoid pressure necrosis of the skin. Under continued traction lateral and axial x-rays are made to determine if the tuber-joint angle has been restored and if the broadening and the adduction deviation have disappeared. The tuber-joint angle should be somewhat overcorrected, amounting to thirty-five to forty degrees.

FIG. 13

Position of pins in tibia and posterior upper corner of the os calcis.

To retain the good position of the fragments, an unpadded plaster splint is applied, under continuous longitudinal traction, from the tip of the toes to the popliteal space. On the dorsal side the toes are left exposed. The splint is nicked on both sides at the heel and also about the pins to avoid wrinkles. This splint is then fastened with three circular plaster bandages, which must be placed loosely on both sides of the heel in order that they may not be too tight over the depressions caused by the pressure of the pads. Care must be taken to insure good modelling; there should be no pressure on either side of the tendo Achillis. The forefoot must be held constantly in

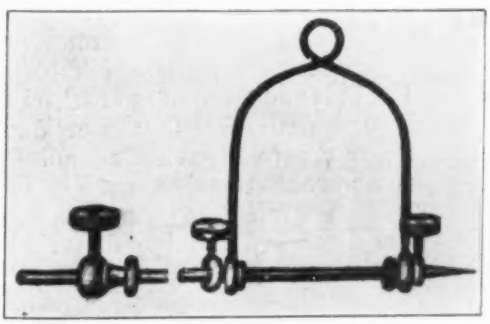

FIG. 14

Pin with freely turning stirrup.

plantar flexion and pronation, and, at the same time, the great toe be held in dorsiflexion.

After a few minutes, when the plaster has hardened, the traction is released, the stirrups are removed, and the limb is placed upon a Braun's splint (Fig. 16). The two pins now hold the fragments immovably in the plaster cast. For the next forty-eight hours the circulation of the toes must be watched very closely and if the toes are swollen, bluish, or cold the plaster dressing must be split immediately; this, however, occurs but rarely. Formerly both pins were removed immediately after completed reduction; but this did not prove advisable, because the tuberosity of the os calcis was again displaced upwards by the pull of the tendo Achillis, and the tuber-joint angle became diminished or even disappeared.

Should the skin break during reduction, the pins must be removed to avoid infection; in this case it is better to eliminate at once the pull of the tendon, by achillotenotomy. If signs of inflammation appear, the pins must be removed at once; but otherwise they remain in place for three to five weeks according to the degree of fragmentation. At this time the

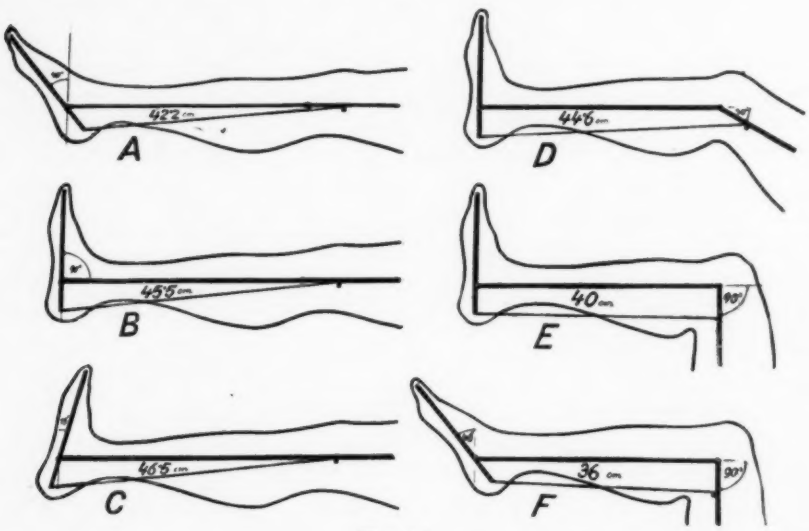

FIG. 15

A. In extension of the knee and maximum plantar flexion of the foot, the gastrocnemius measures 42.2 cm.

B. In extension of the knee and with the foot at right angle, the gastrocnemius measures 45.5 cm.

C. In extension of the knee and strong dorsiflexion of the foot, the gastrocnemius measures 46.5 cm. This is the most unfavorable position for reduction of fractures of the os calcis, or of the malleoli with posterior displacement.

D. In knee flexion to 30 degrees and foot at right angle, the gastrocnemius measures 44.6 cm.

E. With knee and ankle flexed at right angles, the gastrocnemius measures 40 cm.

F. With the knee flexed at right angle and the ankle in maximum plantar flexion, the gastrocnemius measures 36 cm. This is the most favorable position for the reduction of fractures of the os calcis, the astragalus, and of the malleoli with posterior displacement.

FIG. 16

Finished plaster dressing after reduction of fracture of os calcis. The dorsal side of the toes is free. The forefoot is in slight plantar flexion and pronation. The two pins are still imbedded in the bones, holding the two reduced fragments immovably against the plaster cast.

FIG. 17

"Walking" plaster cast with "walking" stirrup in fracture of the os calcis. X-ray sketch and dates of history are recorded upon the cast: V-5, accident; V-12, reduction; VI-9, "walking" cast; VII-28, date for removal of cast.

plaster and pins are removed and a new plaster cast with walking stirrup (Fig. 17) is applied, which remains until nine to fourteen weeks after injury. If this is removed too soon, the soft callus may yield to pressure and new axial kinks of the bone may occur. A zinc glue dressing is applied for the after-treatment to avoid subsequent swelling and flat-foot plates of strong material with lateral flange are used.

Complete functional ability of the foot is observed after from four to eight months, varying with the age of the patient and the degree of comminution of the bone.

When the form of the crushed os calcis has been successfully restored in the manner described, the gait becomes normal, pronation and supination become partly or even completely free, the patient can walk on his toes, and has a normal play of the foot.

To date more than one hundred fresh fractures of the os calcis have been treated with this method. The accompanying pictures demonstrate the results.

ESTIMATE OF DISABILITY

Immediate diagnosis is of importance not only for the treatment, but for the evaluation of the injury as well. Clinically, the broadening of the os calcis, the traumatic flat-foot, and inability to pronate or supinate the foot are evident. In the lateral x-ray view, old fractures appear apparently normal and the structure of the bone continuous; but if one follows

FIG. 18

Comminuted fracture of the os calcis with marked broadening, axial picture. The lateral wall is broken off and protrudes; medially the sustentaculum bulges out. The os calcis is shortened.

FIG. 19

Lateral view. The body of the astragalus has penetrated deeply into the body of the os calcis; the angle between the upper joint line and the posterior process has disappeared.

FIG. 20

Check-up on Fig. 18. The os calcis is again of normal width and length.

FIG. 21

Check-up on Fig. 19. The posterior joint space between astragalus and os calcis is again of normal width; the angle between the upper articular surface of the os calcis and the posterior process is restored and measures 30 degrees.

the tuber-joint angle one notices that it has become smaller, or has disappeared, or even become reversed. This point alone makes the diagnosis of fracture of the os calcis certain. Moreover, the lateral view makes a distinction easily possible between ordinary flat-foot and one due to fracture of the os calcis. In the ordinary flat-foot the axis of the astragalus is slightly deflected plantarwards; in fracture of the os calcis, the astragalus stands horizontally (Fig. 30).

Still more certain is the diagnosis from the axial x-ray picture which shows at once the broadening and shortening of the bone. Therefore, for accurate diagnosis two x-rays are always necessary,—one taken in the

lateral and one in the axial plane. In case of doubt, lateral and axial pictures are taken of the normal side for comparison (Figs. 18–29). Dorso-plantar pictures showing the joint between os calcis and cuboid are usually unnecessary.

The smaller the tuber-joint angle, the more pronounced is the traumatic flat-foot. If, at the same time the os calcis is broadened and, therefore, shortened, then the lever arm for the tendo Achillis has become too short and the

FIG. 22

Fracture of os calcis with marked shortening and broadening, and with adduction position of the tuberosity.

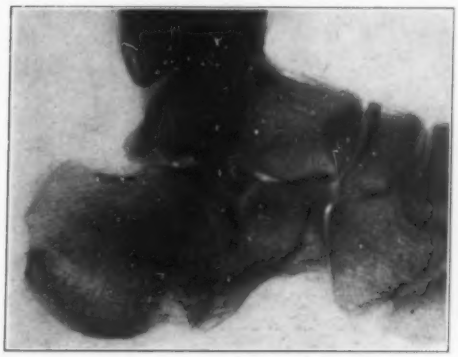

FIG. 23

Lateral view. The tuber-joint angle has disappeared; the os calcis is greatly comminuted. The lateral torsion of the posterior joint face is driven far downward.

FIG. 24

Check-up on Fig. 22 after eight months. The os calcis is again of normal width and length. Good axial alignment.

FIG. 25

Check-up on Fig. 23. The tuber-joint angle is restored. Regular bone structure.

tendon is relatively too long (Figs. 31-A and 31-B). The patients are consequently unable to stand on their toes, or to ascend a ladder; they are therefore disqualified to work as mechanics, painters, brick-layers, carpenters, etc., especially if the condition is bilateral. The gait on even ground has lost its elasticity, because the foot, owing to the insufficiency of the tendo Achillis, can no longer have free motion. On uneven ground walking becomes very difficult because the foot cannot adapt itself to the irregular surface since pronation and supination are abolished.

I have seen patients who had only a lateral x-ray picture; consequently no diagnosis had been made when the disability was determined. These patients, therefore, were denied

FIG. 26

Fracture of the os calcis. Prying off of the outer wall; slight shortening.

FIG. 27

Lateral view of Fig. 26. The tuber-joint angle has almost disappeared and the tuberosity has moved upward.

FIG. 28

Check-up on Fig. 26. The os calcis is again of normal length and width.

FIG. 29

Check-up on Fig. 27. The tuberosity of the os calcis is pulled downward and the tuber-joint angle is again larger, although not yet normal.

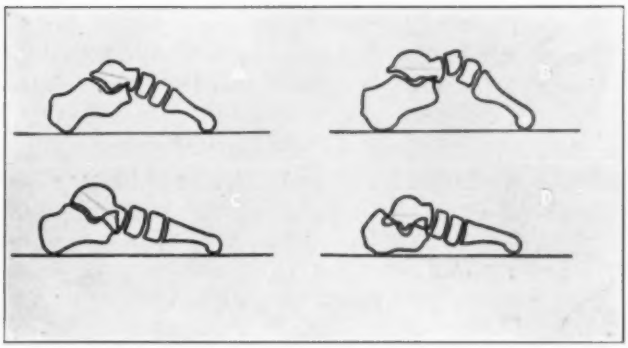

FIG. 30

A. Normal foot with astragalus inclined forward.
B. Hollow foot with horizontal astragalus and high longitudinal arch.
C. Flat-foot with strongly inclined astragalus and low longitudinal arch. The anterior portion of the astragalus has slipped downward over the median side of the pronated os calcis.
D. Fracture of the os calcis with horizontal astragalus and flattened longitudinal arch. The posterior portion of the astragalus has penetrated into the body of the os calcis.

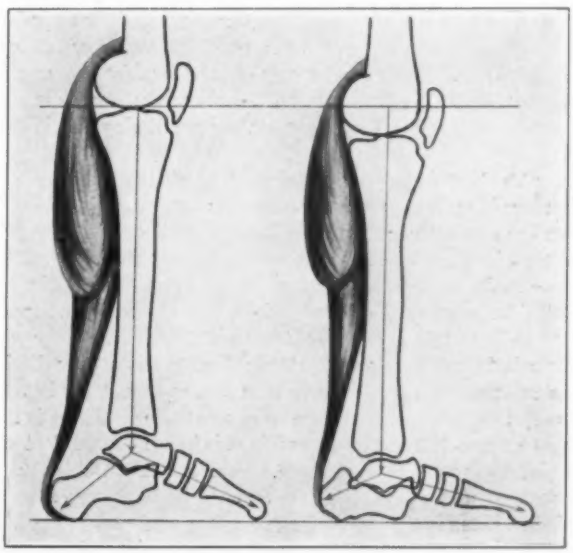

FIG. 31-A FIG. 31-B

Fig. 31-A. Normal leverage relation between the os calcis and calf muscles.
Fig. 31-B. After fracture the os calcis has become lower and shorter. Since the lever arm of the posterior process of the os calcis, as well as the entire leg, is now shorter, the calf muscles are relatively too long. The patient, therefore, can no longer walk on his toes nor can he employ his foot in normal manner.

compensation, all because the existing flat-foot and the loss of pronation and supination were considered signs of inflammation and not of injury. Great injustice to these severely injured can be avoided by determining the tuber-joint angle in the lateral x-ray picture and by taking also, as a routine, x-rays in the axial direction. The severe complaints in unreduced fractures of the os calcis last from one to two years; after which time the patient accommodates himself, in a measure, to his condition.

DISCUSSION

Dr. E. S. Geist, Minneapolis, Minn.: Dr. Böhler's work on fresh fractures appeals to the orthopaedic surgeon because it takes into careful account the knowledge of anatomy and physiology of bones, muscles, and joints; it necessitates acquaintance with the laws of physics, all of which are among the requirements of a successful orthopaedic surgeon.

During a visit to Dr. Böhler's Clinic in 1929, I was impressed with the large amount of fracture material available,—four to eight new cases a day. I was further impressed by the Yankee-like activity of the place. It was pleasing to note the courtesy that was shown the patient as well as the student and visiting surgeon.

In Dr. Böhler's moving pictures you have seen some of the high spots of his work. The anaesthesia used is either local, conduction, or spinal. One is impressed by Böhler's method of squeezing out the oedema from the tissues about the ankle in a fracture in that region before the cast is applied. This is only one of many similar *nouveautées* in Böhler's Clinic.

Among others may be mentioned the almost entire use of the unpadded plaster cast. To some this may sound heretical, but I recommend you to follow Böhler's directions as he gives them in his book. The masseur and physiotherapist are practically absent in Böhler's Clinic. His method is a strictly functional one and therefore of especial appeal to us as orthopaedic surgeons. For the same reason the crutch is frowned upon in Böhler's Clinic.

Since October 1929, we have tried to follow Böhler's teaching in about one hundred cases of fresh fracture in private practice and have not regretted it. Now is the first time since I have been in practice that I welcome the fresh fracture without misgiving.

Böhler has combined old and new ideas, original and otherwise. He has put them into a unified and easily applicable working whole. In other words, to my mind, he has for the first time successfully standardized the treatment of fresh fractures. I believe we have a right to talk of "Böhler's method".

Dr. Charles L. Scudder, Boston, Mass.: I esteem it a very distinct privilege to speak to this Association because I believe that you represent the best in this country, an organized group interested in sound fracture treatment. There is no association in America which as a group is more interested in this important subject of fractures.

I am keen also and proud to speak of the work that Dr. Böhler has so well demonstrated here today. I understand that approximately 1000 men from North America attend his Clinic in Vienna in a year,—a large number, and every man whom I have seen returned from that clinic enthusiastic over what he had seen, and has been stimulated to try certain methods there shown. That, of course, speaks for itself of the appreciation of the kind of work that is witnessed.

There is one phase of Dr. Böhler's work which I think should not escape our attention. We recognize that Dr. Böhler stands on solid fundamentals including a knowledge of pathology, the necessity for restoration of form, and the bringing about eventually of as nearly normal function as is compatible with the injury. The methods which he employs are distinctly methods which he has evolved and which it is interesting to know about, even though the methods themselves are not new. They are not universally

applicable without minute and personal supervision, similar to that which he is enabled to give. Whether his methods are generally applicable to conditions in this country is another matter well open for discussion and one for each individual to decide. Very detailed and personal supervision are absolutely essential in the use of his methods. Of course that is the crux of the introduction of any method. We are not to judge of a method altogether by the accidents which happen, but by the employment of the method properly safeguarded.

There is one thing I would like to say and that is this. There is a great constructive movement throughout this country, Canada, and the whole world, for that matter, in connection with the improvement of fracture treatment. Dr. Böhler represents the beginning of this movement in Austria. He was too modest to mention the fact that the University of Vienna, recognizing his accomplishments, has placed him on the list of teachers. He is now to be connected with the University in the teaching of the treatment of fractures to undergraduates. I think this action of the University of Vienna should be welcomed by us in this country, where we are so much concerned with undergraduate and graduate teaching, as an especially good omen. We all congratulate Dr. Böhler and wish him great success in his University connections.

STENOSING TENDOVAGINITIS AT THE RADIAL STYLOID PROCESS

BY PHIL. HOFFMANN, M.D., ST. LOUIS, MISSOURI

The splendid paper, "Stenosing Tendovaginitis at the Radial Styloid Process", by Dr. Harry Finkelstein, which appeared in *The Journal of Bone and Joint Surgery* for July 1930, proved to be of especial interest to me, and I offer the following in the interest of historical and statistical completeness.

In May 1898, I presented to the American Orthopaedic Association a paper entitled "A Common, Undescribed Affection of the Extensor Muscles of the Thumb". This was published in the Transactions of the Association for 1898 (XI, 252), and in the *Medical Fortnightly*, St. Louis, Missouri, August 15, 1898 (XIV, 451).

In that paper I reported twelve cases of chronic thecitis of the extensor tendons of the thumb, which I had observed and treated during the two years immediately preceding.

The symptoms tend to be rather misleading to one who is not on the alert for these cases, and that these cases are quite common was inferred from the occurrence of so many of them in a comparatively small clinic.

This, coupled with the facts that I could not find reference to the affection in the literature (I did not then know of the single publication of de Quervain in 1895[1]) and that most of my patients had been seen by other surgeons without a correct diagnosis being made and that all of them had had distressing and disabling symptoms for a number of weeks or months before I saw them, suggested that the condition was rarely recognized, and I believe that this holds true to a great extent today.

My first case was in a woman who had suffered pain about the styloid process of the left radius for about three months. This had largely incapacitated her hand and frequently interfered with sleep. Though unable to make a diagnosis, I supported her wrist, first with adhesive plaster and later in a plaster-of-Paris splint (as usual, leaving the thumb free), without giving her the slightest relief. After ten or twelve days of fruitless treatment, my attention was directed to the thumb when, while removing the splint, I caused acute pain by accidentally, suddenly, and forcibly flexing it and stretching its extensor tendons. This led to further investigation, which brought to light the characteristic symptom-complex described in my paper.

Since the publication of this paper in 1898, I have seen several of these cases each year; and further observation has taught me that the pathology is confined to the tendon sheaths of the abductor longus and extensor brevis pollicis (In my paper I used the old nomenclature, "extensor ossis metacarpi pollicis and extensor primi internodii pollicis") and that the extensor longus pollicis (old nomenclature, "extensor secundi internodii pollicis") is rarely, if ever, involved.

I have treated all of my cases conservatively,—that is, in a well fitting plaster-of-Paris splint extending from the tip of the thumb to the middle of the forearm, with the thumb in full extension and abduction. In order that the patient may have full use of the other four fingers, I leave as much as possible of the palm and dorsum of the hand uncovered. Use of the hand is painless and does not seem to retard recovery, so long as the thumb is fixed in full, though not forced, extension and abduction.

Some of the patients passed from under my observation while still under treatment, and in these I do not know the outcome; but in those that remained under treatment until discharged, the immobilization method gave uniformly good results. Most of these recovered in from six weeks to three months; few took over four months.

The affection, if untreated, may cause much suffering and prolonged and severe disability. Some of my patients had had symptoms for as long as two years and had passed through the hands of several surgeons without a correct diagnosis being made.

1. DE QUERVAIN, F.: Über eine Form von chronischer Tendovaginitis. Cor.-Bl. f. schweiz. Aerzte, XXV, 389, July 1, 1895.

SCOLIOSIS TREATED BY THE FUSION OPERATION AN END-RESULT STUDY OF THREE HUNDRED AND SIXTY CASES

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In 1923 a study was made and published of fifty-nine cases of scoliosis treated by the spine-fusion operation at the New York Orthopaedic Dispensary and Hospital[1]. During 1927–1929 this study was continued and this paper reviews the 360 cases of scoliosis treated by fusion from June 1914, when the first operation was performed, to June 1927, covering a period of thirteen years.

Aside from learning the end results in these cases, we were interested in the following problems:

1. What are the indications for spine fusion in the treatment of scoliosis?

2. Will fixation of a section of the spine by fusion in scoliotics: (*a*) prevent progress of the deformity; (*b*) maintain a previously gained correction?

3. What method of correction of scoliosis has proved most effective?

4. Is there a relationship of progress of scoliotic deformity to growth of the vertebral column?

NUMBER OF OPERATIONS

In the 360 cases reviewed there were 427 operations. In thirty-seven cases of fusion of a dorsal curve, a lumbosacral fusion was also done for anomalies in that region; in nineteen cases in which the original fusion proved inadequate as to length, it was extended, usually downward, at a second operation; in seven cases a pseudarthrosis in the fusion area was repaired; and in four cases the fusion was done in two sections because of the length of the involved area. It has been our experience that the longer the area fused at one operation, the greater is the patient's postoperative reaction.

The mortality in these 427 operations was one and six-tenths per cent., or seven cases. Death was due to postoperative pneumonia in two cases

and to shock in two others. In the two latter cases thirteen vertebrae were fused at one operation. One patient died from septicaemia following an infected hematoma; another, twenty-six days after operation, of pleurisy-pneumonia; and the seventh, three weeks after operation, of an intestinal condition not related to the operation.

ETIOLOGY

Of the 360 cases, sixty-three per cent. (228) were females, thirty-seven per cent. (132) males. There was definite evidence of infantile paralysis, which was the cause of the curvature, in forty-four per cent. of the cases (females 76, males 84); of congenital anomalies in four per cent. (females 11, males 3); and of empyema in two cases (both males). The remaining 184 cases with an undetermined etiology may include some scoliosis due to rickets, but in no case was it possible to prove that rickets caused the curve. The majority, though having no positive evidence of infantile paralysis, we believe may have been due to an intrinsic muscle imbalance from this cause, the curvature being the only evidence of this fact. An analogous situation is present in the cavus foot from an intrinsic muscle imbalance.

The onset of scoliosis is confined almost wholly to the pre-adolescent years. In fifty-six per cent. of these cases the curve was first noticed when the patients were from five to fifteen years of age. Only six per cent. were recognized after the age of fifteen. In many of these the onset may have occurred much earlier but because of the lack of pain and of careful parental observation the deformity was not recognized.

Fusion of a part of the posterior elements of the vertebrae was found at operation in seven and seven-tenths per cent. (28 cases). It is interesting to note that natural fusion was present in thirty-six per cent. of the cases with congenital anomalies. The oldest patient having natural fusion was twenty-two; the youngest was five; the average age at operation was sixteen years. Two to five vertebrae were found fused in twenty-three patients. In four there were two areas of two vertebrae each, and in one case three separate areas of two vertebrae each. This fusion by nature was in no case adequate to prevent increase of deformity.

The fusion area must be adequate in length, depending upon the extent of the curve, to prevent increase of the deformity and maintain correction. The fusion extended in each instance between the vertebrae at each end of the curve which showed no rotation of the body as determined by roentgenogram. The longest fusion area, in the dorsal and dorsolumbar regions, was fifteen vertebrae (seventh cervical—second lumbar).

REVIEW OF TREATMENT

The cases are divided into three chronological groups based on distinct differences of treatment. In the first, from 1914 to 1919, our pre-operative

corrective measures consisted of body jackets applied under gravity traction, Abbott jackets, and bed traction. Removable support, such as Knight corset or jacket or bed traction with or without lateral pressure, was used for only eight weeks after operation. In the second period, from 1919 to 1923, fenestrated fixed jackets with pads forced in over rib angulations were occasionally used. Fixed jackets with head pieces were applied under regulated horizontal traction from pelvis and head. Traction was also applied to one side of the pelvis to level the ilia. In 1920 we first used a short body jacket with a lateral hinge and turnbuckle incorporated for wedging, which proved a more effective means of correcting lumbar curves. These corrective measures were removed at the time of operation and applied again a fortnight later for a period of eight weeks, after which the patient was allowed up in a removable jacket, which he wore for a period of from six to twelve months. From 1923 to 1927 corrective measures were essentially the same. In the postoperative care during this period a plaster shell was sometimes used for two weeks following the operation, and then replaced by a fixed jacket for from five to twelve months, thus insuring constant support while the fusion area was maturing. In 1924 we operated for the first time through the fenestrated back of a lateral hinge jacket, thus providing uninterrupted correction for three months. The result in this case was excellent.

Eighty-eight per cent. of these patients were operated upon when they were between ten and twenty years of age. Of these, forty per cent. were between the ages of eleven and fifteen years. It is our opinion that the operation should be done early in the progress of the deformity, it being easier to prevent scoliosis than to correct it. Of the patients over twenty it may be said that most of them were operated upon for relief of pain, and many of the conditions were of congenital origin. The oldest patient was forty-six years; the youngest, one year and eleven months.

FOLLOW-UP

From 1927 to 1929 these 360 cases were reviewed as follows: 245 were examined and roentgenographed; thirteen were examined but not roentgenographed; four not examined answered a questionnaire; twenty-three patients not seen at this time had a previous study two or more years after operation. These 285 cases constitute seventy-nine per cent. of the total. Of the remaining twenty-one per cent., seventeen have died and fifty-eight were not available for the present study. The elapsed period since operation was for sixteen patients, from ten to fifteen years; for 113, five to ten years; and for 156, two to five years.

In judging the end results we have found that photographic comparison gave only a gross impression of the body outline, so we have obtained in every available case roentgenograms of the spine. These were taken in the sitting position, which illustrates the effect of weight thrust upon a curve and the fusion area, and were comparable with sitting views previously taken.

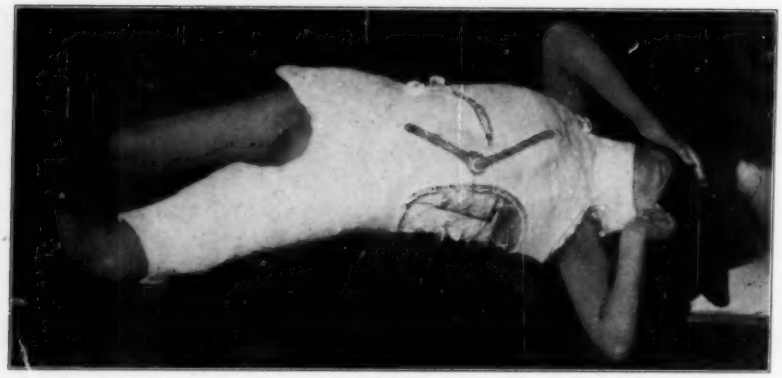

FIG. 1

(Figs. 1 to 4 inclusive are views of different stages in the process of correction.) Jacket applied under horizontal traction, showing outline of anterior hinge, lateral fenestration over the convexity of the curve, and section of cast over concavity of curve for placement of turnbuckle.

MEASUREMENT OF LATERAL CURVATURE

The degree or severity of the lateral curvature is determined roentgenographically by measuring the angle of the curve as follows: A line is drawn from the center of the shadow of the body of the vertebra at each end of the curve (the so called neutral body) to the center of the body at the apex. The angle of deviation of these lines from a straight line (180 degrees) is measured. The vertebra nearest a non-rotated position is regarded as the end of the curve, and the most rotated vertebra is the apex. The limit of error by this method is from three to five degrees.

Correction of lateral curvature is dependent not only on the method of correction used but on the mobility of the spine and the amount of structural change in the vertebral unit. Decrease or increase in lateral

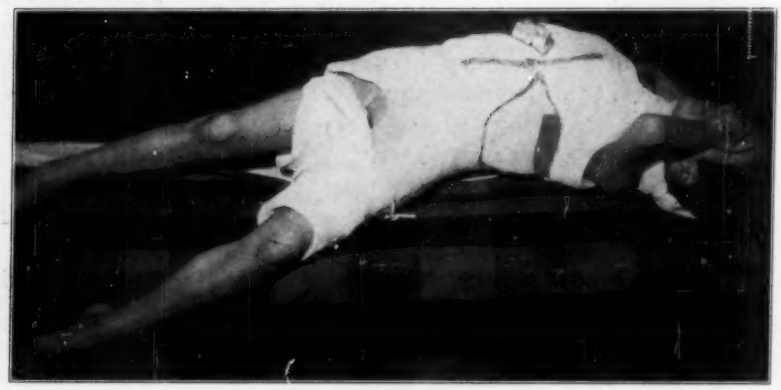

FIG. 2

Jacket partially bent by means of the turnbuckle.

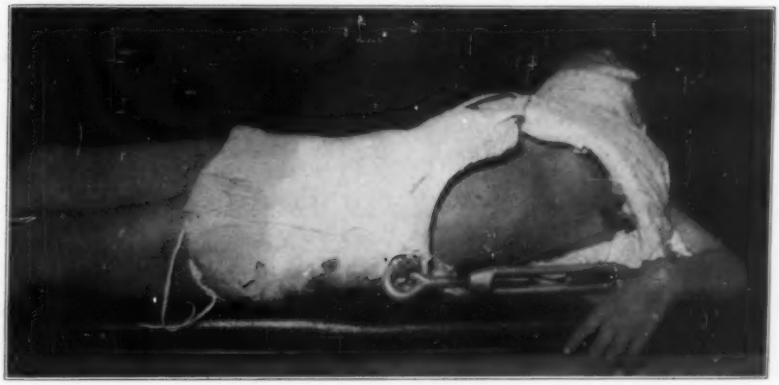

FIG. 3

Maximum correction obtained; jacket fully bent and ready for reenforcement and fenestration. In the high dorsal curve a hip spica is not incorporated.

curvature occurs at the vertebral joints. The greater the mobility, the greater the correction. The amount of possible correction is less in the upper dorsal than in the mobile lumbar spine. And the more structural deformity in the vertebral body, laminae or lateral articulations, the less will be the correction. There is less deformity and greater mobility in the younger patients, and in these we obtain the greatest relative correction. On an average, both the degree and percentage of correction in similar areas of the spine vary directly with the age of the patient and duration and severity of the curvature. It is difficult to get a high percentage of correction in the smaller curves by the methods we have used. The greatest degree of correction was seventy per cent. in a paralytic girl of fifteen, having a lumbar curve of 102 degrees. We have obtained a correction of eighty per cent. in a thirty-degree curve, whereas the average is

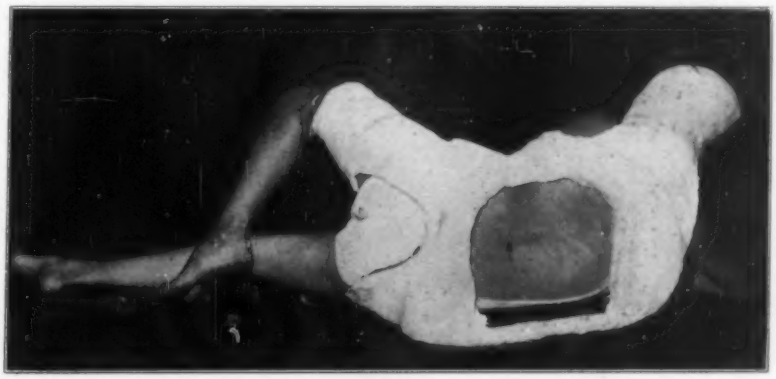

FIG. 4

Jacket reenforced, turnbuckle removed, showing posterior fenestration preparatory to operation. Triangular marker on the spinous process at level of transverse silver nitrate line.

forty per cent. The usual amount of correction varied from fifteen to twenty degrees. No attempt has been made to correct the congenital cases of hemivertebrae.

RESULTS

Of the 285 cases examined twenty-three and five-tenths per cent. maintained from five to fifteen degrees of correction. This percentage has increased from four in Group I (1914–1919) to forty-two in Group III (1923–1927). Three per cent. have maintained more than fifteen degrees of correction. Failure to maintain correction was primarily due to the fact that there was either inconstant or no support while the fusion was maturing.

Increase in the curvature, except in cases with pseudarthrosis, occurred outside of the area of fusion. This difficulty was due to a failure to include a sufficient number of vertebrae in the fusion. The number of cases subject to this error has been lowered from thirty-one and five-tenths per cent. in Group I to twelve per cent. in Group III.

The curvature increased if the fusion was placed outside of the area of curvature. These cases were confined almost wholly to those in whom lumbosacral fusion was expected to stabilize a dorsolumbar curve (four per cent. of the cases examined).

Not including those patients who maintained correction, there were fifty per cent. whose curvatures showed no increase after fusion beyond the original curve. It is interesting to note that there was no case fused at seventeen years or older that had an increase of deformity. And yet all, irrespective of age, were subject to the same errors of inadequate and inaccurate fusion areas. We may conclude, therefore, that an increase in lateral curvature beginning in childhood is in a great measure determined, other things being equal, by the rapidity and duration of vertebral growth.

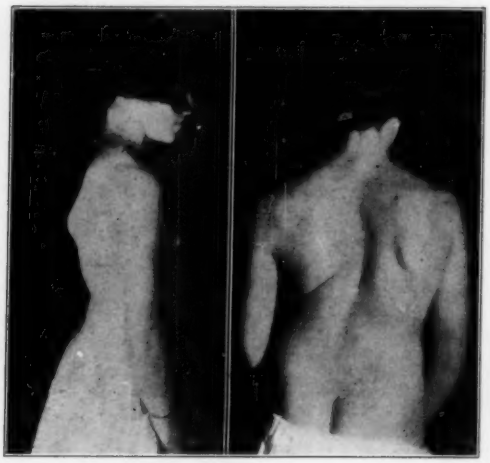

FIG. 5

Case No. 102673. Anna B., age thirteen. Curve first noticed.

By careful observation and measurements of sitting and standing heights in a series of untreated scoliotics, we have found that females apparently complete their vertebral growth at fourteen to sixteen years of age and males at fifteen to seventeen[2]. In those patients who have completed their vertebral growth, as indicated by sitting height, we have so far been unable to prove a further increase

of curvature, but there was more or less consistent increase of curvature in the cases under seventeen, during the period of rapid vertebral growth.

We must then consider the results in all pre-adolescent cases as doubtful, for the curvature may yet increase if the fusion difficulties have not been controlled. There were thirty-three patients who were operated upon while very young and who are not yet out of the adolescent period. These cases are being followed until after the adolescent period before accurate results concerning them can be determined After subtracting these cases our results are as follows:

One and five-tenths per cent. maintained more than fifteen degrees of correction.

FIG. 6

Case No. 102673. Anna B., age thirteen. Curve first noticed: sitting view.

FIG. 7

Case No. 102673. Anna B., six months later. No treatment; sitting view.

Twenty-one per cent. maintained from five to fifteen degrees of correction.

Forty seven per cent., exclusive of the above, showed no increase of curvature. The total cases showing no increase of curvature is then sixty-nine and five-tenths per cent. The increase of deformity in the thirty and five-tenths per cent. was due to short or inaccurately selected areas of fusion.

Although these results are based on roentgenographic comparison, the pre-operative roentgenograms of many of the cases in the first and second groups, and a very few in the third group, were either not recorded in angles or were not comparable views. The results in these cases were estimated primarily upon photographic comparison. Of the eighty-one cases having insufficient roentgenographic evidence, only four were in Group III (1923–1927), thirty-four in Group II (1919–1923), and forty-three in Group I (1914–1919). A classification of these separately shows a greater proportion with no increase of curvature. This method of estimating results is apparently less accurate.

PSEUDARTHROSIS

From clinical and roentgenographic examinations pseudarthrosis was suspected in fifteen cases. Of these, seven were explored and pseudarthrosis was found and successfully repaired within two years after the original fusion. The failure of fusion was, in eleven cases, at the crest of the curve, which was most frequently at the dorsolumbar juncture; and in four cases at the fourth and fifth lumbar. Ten of the fifteen had extensive infantile paralysis.

Loss of correction shown by either clinical or roentgenographic examination is the most constant sign of pseudarthrosis. It is most frequently noticed immediately after the removal of the supporting jacket and continues slowly to increase for the next few months. If growth is a factor, the increase in deformity may continue much longer. In adults the increase did not go beyond the original curve, but in pre-adolescents there was an increase in curvature beyond the original curve in some cases, especially when the pseudarthrosis was located near the lower end of a short area of fusion. There was a complete loss of correction in

FIG. 8

Case No. 102673. Anna B., six months later. No treatment. Vertebral growth was rapid and increase in deformity marked.

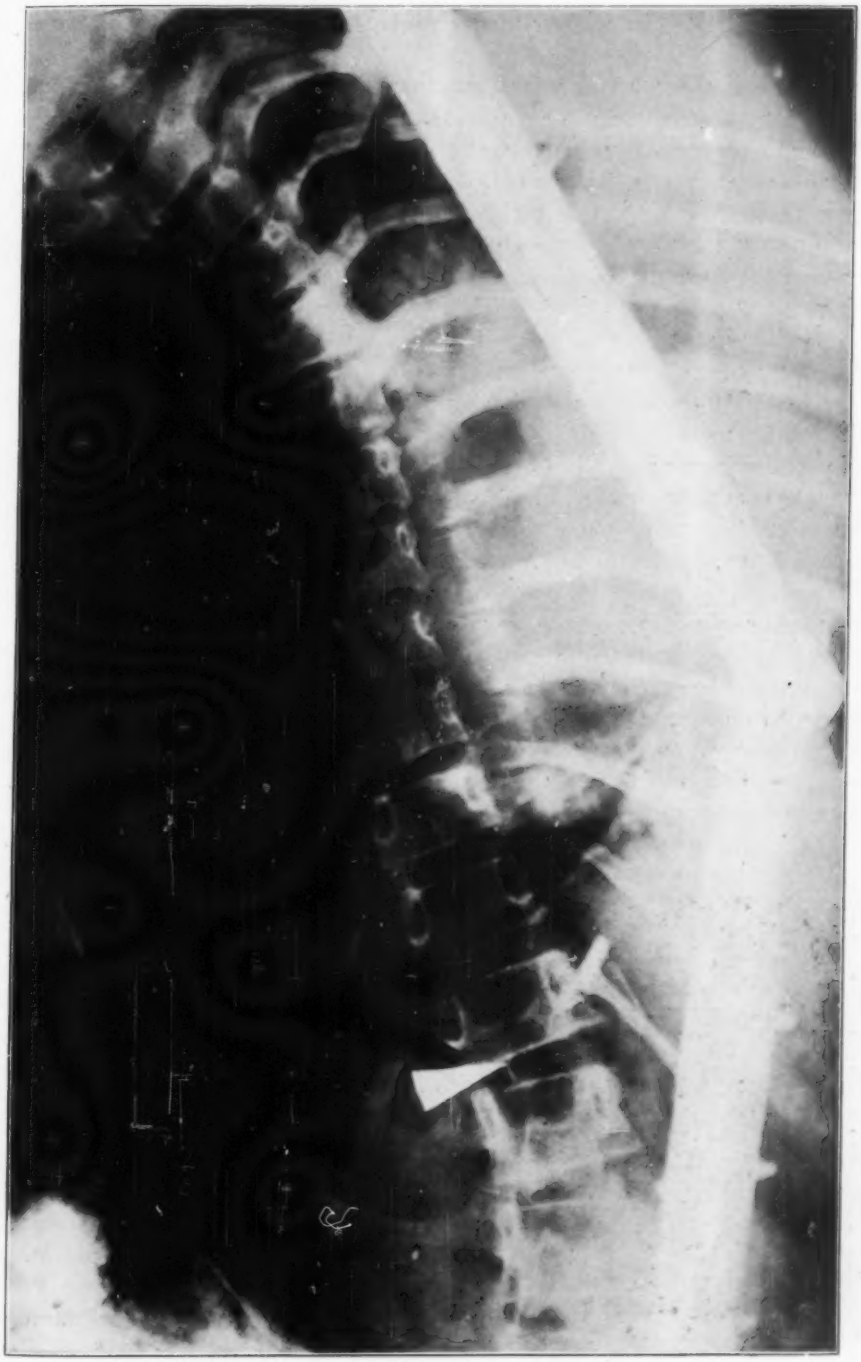

FIG. 9

Case No. 102673. Anna B. Maximum correction in bent jacket. Triangular lead marker identified spinous process in fusion area, dorsal six to lumbar two.

six cases, partial loss in four, and an increase over the original curve in three cases.

The patients with pseudarthrosis usually complain of fatigue or pain which may radiate along the course of the intercostal nerves, on either the convex or the concave side of the curve. Tenderness to deep pressure over the fusion may also be present. It is difficult to demonstrate motion through the pseudarthrosis by clinical or roentgenographic examinations. Pain due to the pseudarthrosis is almost invariably located at or near the crest of the curve, where the stress and strain are greatest.

FUSION AREAS

In thirty-one cases of fusion of a dorsal curve a subsequent fusion of the lumbosacral area was performed because of an incomplete sacralization of the fifth lumbar vertebra or a severe lumbosacral angle, either of which was a potential source of pain. In a few cases the lumbosacral area appeared unstable because of asymmetrical lateral articulations, or a lateral wedging of the fifth lumbar vertebra. It would seem that a lumbosacral fusion in addition to a dorsal fusion was effective only in so far as it made a more extensive fusion area; that many of these cases would have shown no increase in curvature if the low back area had not been added; that the free unfused lumbar spine was in a few cases the crest of a severe curve and subject to future pain. The better solution would have been to extend the dorsal fusion down through the crest of the lumbar curve, covering the area of structural deformity and leaving a free lumbosacral area for mobility.

The selection of the area of fusion is most important[3]. Fusion of only the secondary curve allows increase of the primary curve and prevents further compensation in the secondary curve. This difficulty arises most frequently in early paralytic high dorsal curves. The longer secondary dorsolumbar curve attracts most attention, especially if roentgenograms do not show any or all of the high dorsal curve.

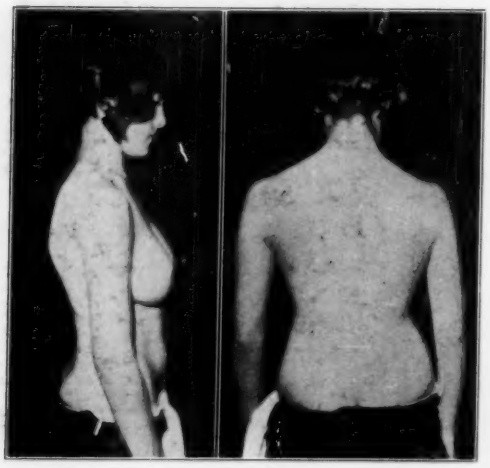

FIG. 10

Case No. 102673. Anna B., two years after correction and spine fusion (sixth dorsal to second lumbar), and one and one-half years after the removal of all support.

Fusion of the lumbosacral area in an attempt to maintain correction or prevent progress of a lumbar or dorsolumbar curve has proved of little value in this series. Of the twenty-three cases having only a lumbosacral fusion, eight oper-

ated upon at seventeen years or older showed no increase of deformity. Of the fifteen operated on under seventeen years, eight had an increase of curvature. Fusion of this area was effective for the relief of pain in the lower back.

The sacrum should be included in the fusion when the lumbosacral juncture is a definite cause of pain, which may be due to an incomplete sacralization of the fifth lumbar or asymmetry of its lateral articulations or a severely acute lumbosacral angle. Also, the sacrum should be included in the fusion when it is part of a lumbar curve, causing an unstable pelvis. This condition is most frequently seen in paralytics with involvement of the trunk and lower extremities.

FUSION FOR PAIN

A spine fusion was performed on eighteen of this series because of pain in the back. Fifteen were entirely relieved by fusion and three partially relieved. In two of these the fusion area was inadequate and did not include all the deformity, which was severe in both cases. Those with severe deformities require a long fusion area, for frequently pain is in a deformed secondary curve as well as in the primary one. In the third case, only partially relieved, from roentgenographic examination we suspect a pseudarthrosis. Nine of the eighteen had spinal anomalies, four of them had hemivertebrae, and five lumbosacral anomalies; all of these patients were under twenty-five years of age at time of operation. Two cases had a scoliosis combined with a dorsal wedging round back. At time of operation five, whose ages varied from fourteen to forty-six, had very severe curvatures. The usual age period of the patients operated upon for pain was from twenty to thirty years.

In considering the benefits to the scoliotic patient from a spine fusion we must not overlook the fact that a sense of fatigue present in most cases is relieved by stabilizing the area of curve.

FIG. 11

Case No. 102673. Anna B., two years after operation or one and one-half years after the removal of all support. Sitting view.

In this series practically all the patients examined stated that they felt stronger and were able to work longer following the fusion than before. Although our results in correction are not as perfect as we desired, we must keep in mind that many patients have been saved from having a much greater deformity due to a progressive scoliosis.

PRESENT TREATMENT

Correction of the deformity in the past has been only moderate in degree and tedious in requiring several jackets over a period of months. To gain correction we have used head and pelvic traction with the patient in a horizontal position. This is without doubt a necessary corrective force, although in itself gaining only moderate correction. Lateral pressure applied by use of surcingles and pads over the posterior or anterior prominence has proved ineffective in our hands. Torsion of the trunk upon the pelvis gives only an apparent or optical effect of producing correction of the deformity.

In 1920 we first used lateral flexion in the correction of scoliosis. This force was made effective in lumbar curves by the use of the lateral hinge turnbuckle jacket. During the last two chronological periods, as mentioned above, good correction of lumbar curves was obtained by their use. The chief difficulty was the discomfort of the patient because of the severe lateral pressure of the hinge, which also limits the degree of lateral flexion or bend. We have obviated both difficulties by superimposing the point of motion or hinge over the crest of the curve, front and back. The lateral area of the cast on the side of the convexity of the curve is cut away, which leaves a space into which lateral bending can take place, and this removes pressure from the patient's body. Extreme lateral bend creates compression of the patient's body on the side of the convexity of the curve which takes the place of lateral pressure as in the lateral hinge jacket. This placement of the hinges in the cast anterior and posterior to the patient's curve combines a fair amount of traction with a maximum amount of lateral bend. This type of jacket is also applicable to a curve in the dorsal, as well as in the lumbar, area.

In using only traction we have gained a fair degree of correction of the lateral curvature, but at the expense of the compensating or secondary curve. The compensating curve can usually be corrected to a greater extent than the primary curve, because there is less contracture and less bony deformity. By the use of the anteroposterior hinge turnbuckle jacket, an extreme lateral flexion of the ends of the spine takes place, creating marked induced curves opposing the curve which is being corrected. The rotation of the vertebral bodies which is secondary to the lateral curvature is greatly lessened, sometimes completely corrected. The fusion area then includes as much of the induced curve as is necessary for compensation. In general, the fusion area in the corrected position extends from a level vertebra at the upper end of the corrected curve to a level vertebra at the lower end of the curve, which level is parallel to the level above.

The postoperative care of the patient is an important factor in maintaining correction. The inconstant supports after operation used in the cases of the first two chronological groups were in a great measure responsible for the failure to maintain the correction gained before fusion. Every manoeuver or corrective force applied after operation tends to jeopardize the solidity of the fusion. Our present procedure is to gain maximum correction before operation by an anteroposterior hinge turnbuckle jacket. To avoid the risk of losing at operation any degree of correction which has been obtained, the custom now is to operate through a window in the jacket. This is somewhat more difficult and requires more time, therefore the fusion is accomplished in short segments at two operations, or, in very long areas, three. The patient remains in the corrective jacket for three months following fusion. We have found that this length of time is necessary to allow the fusion callus to become strong enough to withstand the stresses tending to cause recurrence of the curve. Then the corrective jacket is removed and a supporting jacket is applied without traction, with the patient inclined in the corrected position of lateral bend. This supporting jacket is removed from three to nine months later, making a total of six to twelve months of constant postoperative support. Following the removal of all support, gymnasium work is utilized to improve the posture and general muscle tone after the removal of the cast.

IDENTIFICATION OF VERTEBRAE AT OPERATION

A source of error which is often overlooked is failure to identify the fusion area at the operating table after having once selected it. To fuse a spine one or two vertebrae short because of anatomical variations, to fail to get the proper landmarks, or make an accurate count of the number of vertebrae, will interfere with the maintenance of the maximum correction. So that we may identify the vertebrae in the fusion area the following method is now used: the skin is marked with silver nitrate over the spine of a vertebra in the proposed fusion area, a lead pointer is placed over this mark and a roentgenogram is made. The marked vertebra is then identified and the skin mark is used as a guide at operation. We have found a vertebral identification method a necessity for the best results.

Our conclusions from this review are:

1. Spine fusion is indicated in the treatment of scoliosis: (*a*) to prevent increase of deformity in the progressing scoliotic; (*b*) to maintain a previously gained correction; (*c*) to relieve pain.

2. Spine fusion will maintain a correction of, and prevent increase in, a progressive lateral curvature. To accomplish this, constant support of the correction should be applied for from six to twelve months after operation. In order not to lose pre-operative correction the operation is performed through a posterior fenestration of the corrective cast. The area of fusion should be correctly selected, identified at operation, and should be adequate in length.

3. The best form of correction of lateral curvature in our hands is a combination of head and pelvic traction with complete lateral bend. This is accomplished by the use of an anteroposterior hinge turnbuckle jacket.

4. The increase of lateral curvature is closely associated with the skeletal growth of the spine.

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IMPORTANCE OF CAPSULE ATTACHMENTS IN THE REDUCTION OF CONGENITAL DISLOCATIONS OF THE HIP*

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Although discussion is still active as to the relative merits of the closed and open methods of reduction of congenital dislocations, there is complete agreement that gentleness and lack of trauma are of supreme importance.

The following is a statement of certain anatomical facts, and of a procedure which I believe to be of value in lessening trauma in the open reduction. It is the result of experience and study of open reduction, extending over a number of years. It has taken definite shape from observation in patients between the ages of two and ten years, operated upon during the last eight months.

A review of the literature disclosed that the anatomical facts involved are described in an article by H. A. T. Fairbanks, in the *British Journal of Surgery* (XVII, 380, January 1930), and by Deutschländer (*Zeitschrift für orthopädische Chirurgie* XX, 189, 1908) as quoted by Steindler in his *Textbook of Operative Orthopedics* (New York, D. Appleton and Company, 1925).

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Although these descriptions agree closely with my own observations at operation, I have been unable to find in the literature any mention of their use in the practical procedures involved in reduction.

The following remarks apply only to children under ten years of age. I am not prepared to make any statement as to their value in older cases.

Essentially the anatomical facts involved are as follows:

The capsule of the hip joint is attached to the neck of the femur. In congenital dislocations the neck of the femur rides upwards and backwards along the side of the ilium, carrying with it the whole tube of the capsule. Thus the medial side of the capsule is in direct contact with the side of the ilium, to which it becomes adherent. The older the child, the denser and firmer becomes this adhesion. The higher the dislocation, the larger becomes the area of the medial fold of capsule adherent to the side of the ilium. The highest point of the attachment of the capsule to the side of the ilium corresponds very closely to the highest point of the head of the femur. The head of the femur rests against this layer of the capsule. In older children a false acetabulum is formed, which is lined by this layer of the capsule. The lateral portion of the capsule also follows the upward course of the head of the femur, and stretches and thickens. As the age of the child increases, this lateral layer is more and more tightly stretched across the true acetabulum, so that it forms a diaphragm, guarding the mouth of the true acetabulum. The two layers of capsule together form a suspensory ligament between the side of the pelvis and neck of the femur, which assists greatly in weight-bearing. Conversely, the adhesion of the capsule to the side of the ilium strongly resists the downward motion of the head of the femur when attempts are made to bring the head opposite the true acetabulum. If my observations at operation are correct, this adhesion of the capsule is the principle factor that resists the downward movement of the head in reduction. The muscles attached to the trochanter and to the shaft are of relatively little importance in resisting this downward motion.

The operation based upon the above facts is relatively simple. Through a short Smith-Petersen incision the muscles are separated and the capsule exposed. Wide retraction of the muscles allows approach to the anterior and superior boundaries of the adhesions between the medial portion of the capsule and the side of the ilium. With a blunt osteotome or periosteal elevator, beginning at the top, between the ilium and the head of the femur, the medial layer is gently dissected away from the side of the ilium, the dissection passing downward, both in front and behind. This dissection is easily carried down to the top of the true acetabulum, where the medial layer of the capsule is attached. In the cases so far operated upon, after this dissection has been carried out, it has been found, consistently, that simple traction in the axis of the leg will pull the head of the femur down to the level of the true acetabulum. The capsule is then anteriorly incised in its longitudinal axis, thus exposing the upper border of the acetabulum from the inside of the capsule, as it has just been exposed from the outside.

In every case so far observed, the so called "hour-glass" contraction of the capsule has been found to consist of the diaphragm previously described, which is formed by the lateral layer of the capsule. As the head is pulled downwards, this diaphragm is seen to be reenforced and made much thicker and more bulky across the acetabulum by the infolding of the lateral portion of the capsule. If at this point manual reduction of the head into the true acetabulum is attempted, it will be found that the diaphragm and the reduplicated portion of the lateral capsule form an almost insurmountable obstacle to the replacement of the head within the acetabulum. It is therefore necessary to incise the diaphragm and the infolding of the capsule widely, in the longitudinal plane (Galloway). The true acetabulum is thus clearly exposed. In almost every case, the acetabulum has been found to be much more complete and better shaped than had been expected, because the preceding downward dissection of the capsule from the ilium defines its upper border. Adjustment of the head to the acetabulum is therefore usually easy. If occasionally the acetabulum proves to be insufficient to receive the head, the wide exposure obtained by the foregoing procedures makes it easy to reshape it with a minimum of damage. Actual reduction is carried out in the following manner. The two sides of the incised external layer of the capsule and of the diaphragm are retracted. The head is then gently manipulated, usually without instrumental aid, into its proper position. No stretching of muscles is necessary, nor is any crushing force exerted upon the delicate cartilage.

When reduction has been accomplished, the different portions of the capsule are sutured, to close the joint tightly, in such a manner as to shorten or reduplicate the capsule. In every case when this step has been accomplished, it has been found that the reduction is so stable that large ranges of passive motion may be carried out without luxation. The suture of the capsule, followed by that of the overlying muscles, holds the head within the acetabulum so firmly that it has been unnecessary to steady the leg during the manipulation incidental to closing the skin and applying the plaster-of-Paris cast.

THE PEG LEG CAST

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In a report in 1929[1] of the work of several European clinics, the writer mentioned a special walking cast which was used by Dr. L. Roeren of Süchteln, Germany, in the treatment of coxa plana. His results have been excellent*. In 1912, in the clinic of Geheimrat Garrè of Bonn, Roeren saw a similar cast employed postoperatively. He has not observed the use of the technique elsewhere in Europe. No mention of it is found in the literature and so far as the author can discover, it is wholly unknown in England and America. It has proved so useful and has aroused such interest among the orthopaedic surgeons who have seen it, that a report of the method seems well advised. In addition to its use in coxa plana, the peg leg cast has been found valuable in cases of coxa vara and chronic hip infection. It has been employed following operations about the hip and in the fixation of reduced congenital hip dislocations (Fig. 1). It has recently been used on two middle-aged adults with fractures of the neck of the femur.

FIG 1.

Case 9. The peg leg cast is shown in the fixation of a reduced subluxation of the left hip. The position of abduction and internal rotation need constitute no hindrance to ambulation. This child of twenty-six months soon learned to walk in spite of size (compare with the yardstick). It is generally agreed that activity is good for reduced dislocations and subluxations. There can be no doubt of the child's happiness.

*Personal communication.

The technique of application is best shown by the illustrations (Figs. 2–6).

The various uses of the peg leg cast are illustrated by nine selected cases.

FIG. 2

The affected lower extremity and torso are encased in stockinette. A pad, *C*, is added to allow for abdominal expansion when it is removed. With the patient on an orthopaedic table the lower extremities are equally abducted. If one hip is fixed by spasm or fibrous tissue (the right in this case), the pelvis will be tilted from *A-A'* to *B-B'*, as shown by the outlined anterior superior iliac spines. This apparent abduction later becomes true abduction under the influence of walking in the cast.

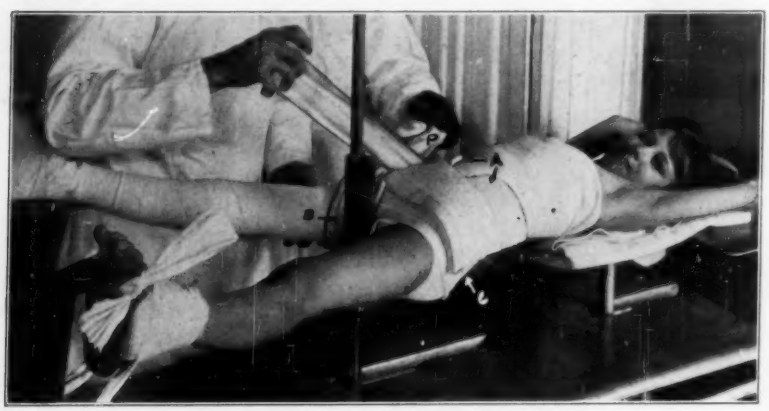

FIG. 3

A thin layer of sheet wadding is applied to the affected lower extremity and chest. This is covered with crepe paper bandage which serves also to anchor the pieces of piano felt which protect the bony prominences. Pads *A* are for the anterior superior iliac spines and pad *C* is for the sacrum. At *B* a rectangular piece of felt encircles two-thirds of the thigh on the affected side, and is pulled snugly against the ischial tuberosity by traction on the bandage *P*. Plaster is applied in the usual manner while this traction is maintained. Reenforcements of plaster bandage are applied to the back and sides of the entire torso. The cast must also be thick just above the symphysis pubis if it is to be cut low anteriorly.

FIG. 4

When the plaster is about to set, it is molded sharply over the anterior superior spines (*A*) and the trochanters (*B*). An assistant prevents sagging of the knee into recurvatum (*C*). Supporting the knee with a bandage is unnecessary and lessens the interior smoothness of the cast.

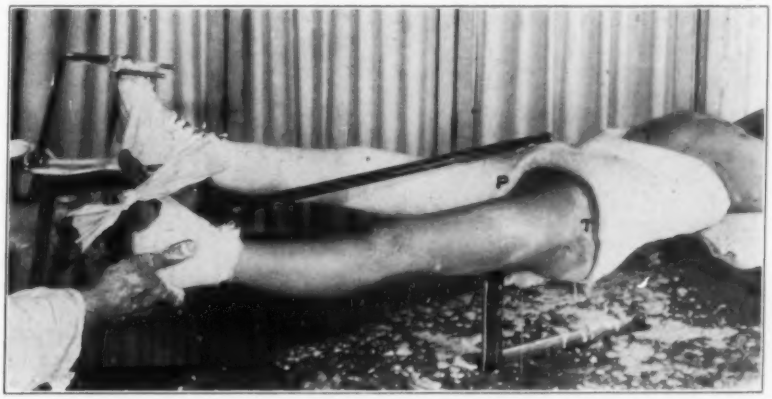

FIG. 5

The cast is trimmed away about the perineum and over the abdomen (*T*). The felt pads should all protrude beyond the plaster. The edge at *P* is carefully rounded and the felt turned back over it. The stockinette is turned back, pulled tight, and fixed to the cast with plaster cream.

The normal lower extremity is then adducted to an indifferent position with relation to the torso of the cast (not the pelvis!). The lower four-fifths or so of an old crutch is sprung over the cast and held in a position symmetrical with the sound extremity.

COXA PLANA AND COXA VARA

CASE 1. Coxa plana.

J. R., a boy of six years, was first seen with the complaint of intermittent pain in the left hip and limp of a year's duration. The onset had been gradual, without acute illness or outstanding injury. There had been no fever, sweats, or loss of weight. The family history was negative for similar disability or tuberculosis. On examination there were: a marked limp on the left, a left total scoliosis, and tenderness on percussion of the left greater trochanter. The hip motions were as follows:

	Right	*Left*
Flexion	80 degrees	75 degrees
Abduction	45 degrees	25 degrees
Adduction	40 degrees	30 degrees
Hyperextension	15 degrees	0 degrees
Rotation outward	25 degrees	20 degrees
Rotation inward	45 degrees	30 degrees

The diagnosis of coxa plana was confirmed by x-ray (Fig. 7). The patient was limited in his activity and given frequent rest periods. Under this regimen there was less pain and the limp diminished. After four months, examination showed only slight limitation of the normal hip motions. The disease process was thought to have reached its terminal stage and the patient was allowed to continue with restricted activity, but without a cast (which had been considered).

One year after the first admission the patient was seen again. There had recently been a recurrence of severe pain, night cries, and a marked limp. There was only a trace of motion at the left hip. There was pain in the hip on percussion of the left trochanter or heel, but no swelling. The left thigh was moderately atrophic. The intracutaneous tuberculin reaction was negative. X-ray showed an increase in bone destruction (Fig. 8). With rest in bed and traction for two weeks there was relief of pain and increase of all motions except abduction, which remained only a trace. Then a peg leg cast was applied. By allowing the pelvis to tilt, an apparent abduction of thirty-five degrees was obtained on the left, but there was actually only fifteen degrees of true abduction of the left femur on the pelvis. After a little practice, the patient was able to walk about all day with comfort. He went home for two months and on his return the cast (Fig. 9) was removed. Abduction of the left hip was possible to thirty-five degrees and other hip motions were surprisingly free. (A patient is now expected to emerge from the peg leg cast with very little stiffness.) A second cast was applied with apparent abduction of forty-five degrees. This soon became a true abduction, as shown by x-ray (Fig. 10). The patient fell once and broke the crutch, which was replaced, but there was no further incident until he returned for the removal of the cast after four months. A pressure sore had developed at the site of a wrinkle over the affected thigh. (Irregularities of the inner surface must be avoided. This was the only occur-

FIG. 6

Case 5. The cast is complete. The crutch is incorporated in plaster, cream being added to the folds of bandage. It is well to reenforce the cast at *R* just cephalad to both ends of the crutch to prevent the latter from wearing through. When a cast is to be worn for a long period (six months) it is well also to drive nails (*N*) through the plaster into the wood to further secure the crutch.

FIG. 7

Case 1. Coxa plana of the left hip with symptoms of one year's duration. The process has apparently reached the stage of maximum deformity.

FIG. 8

Case 1. One year later than the preceding plate and after two years of disability. There has been an exacerbation with further progress of the destructive lesion and fragmentation of the epiphysis. The neck is invaded by localized areas of rarefaction.

rence of a pressure sore in any of the casts applied.) This healed in a week. Motions of the left hip were limited only five degrees in abduction. X-ray showed no appreciable change in the lesion, however, and a third cast was applied for three months, with the lower extremities equally abducted to the maximum and the pelvis abducted slightly to the left. When it was removed hip motions were as follows:

	Right	*Left*
Flexion	90 degrees	80 degrees
Abduction	50 degrees	45 degrees
Adduction	30 degrees	10 degrees
Hyperextension	15 degrees	5 degrees
Rotation outward	40 degrees	40 degrees
Rotation inward	45 degrees	30 degrees
Knee flexion	150 degrees	15 degrees
Length of lower extremity	63.7 cm.	63.0 cm.

After one week of gentle motion in bed, measurement showed the left hip to have gained in adduction and rotation outward, with the other motions the same. The left knee could be flexed to thirty degrees.

FIG. 9

Case 1. A photograph of the first cast in which abduction of 35 degrees was obtained without anaesthesia. In the next spica, the abduction was increased to 45 degrees.

Six months later there was neither pain nor limp, although the father stated that the boy limped a little when tired. Hip motions on the left were almost equal in range to those on the right. Rotation outward was greater on the left. An x-ray (Fig. 11) showed arrest of the disease.

In the literature of recent years there are numerous discussions of the etiology and symptomatology of coxa plana. The consideration of treatment, however, is either omitted entirely, or confined to a few lines. Opinions as to the desirable type of therapy vary from the contention of Nussbaum[2] that only such general measures as motion, massage, heat, and sunshine should be employed, to the recommendation of Phemister[3], McWorter[4], and Kidner[5] of surgical intervention in selected cases.

Legg, Perthes, and Calvé[6] agree that the form of therapy has little to do with the ultimate result, and advise rest as symptomatic treatment. Legg* uses a flannel spica in the mild cases with no further restriction of activity. When there is a marked limp or pain, he employs traction in bed or uses a

*Personal communication.

FIG. 10

Case 1. An x-ray through the second cast. The left hip is in abduction of 45 degrees. Although the patient was ambulatory, this desirable position was maintained and no weight was borne on the hip.

FIG. 11

Case 1. One year after the application of the first cast and three years after the onset of disability at the left hip. The proximal epiphysis is now well rounded and of more uniform density. The residual deformity is considerable, but function is good.

plaster spica and crutches for a short time. He advises against weight-bearing when there are acute symptoms.

Perthes[7] suggests reliance on massage, fresh air, and sunbaths to promote spontaneous healing. He adds, however, that one must use traction or an abduction cast for a few weeks if there is pain or limitation of motion.

Schanz[8] holds that exercises are contra-indicated. Traction during the acute stage should be followed by a year of protection by a splint. Spitzy[9] uses his favorite traction in abduction with extreme foot-end elevation of the bed. He, like Ryerson[10], condemns the cast as conducive to atrophy. Lange[11] goes so far as to manipulate the severer cases under anaesthesia before applying a cast for two to three months. Whitman[13] advocates the use of an abduction spica for as long as the symptoms persist. Haglund[15] favors a cast in extreme abduction followed by a hip brace, even in the milder cases. In the book of Jones and Lovett[16] protection from weight-bearing is suggested, and in severe cases, fixation of the joint.

One finds in summarizing the literature that the Thomas walking caliper, the plaster cast in some degree of abduction, and traction in bed are the favorite methods of treating coxa plana in the active stage. With a few exceptions surgeons incline to some form of protection for the affected joint.

Extreme abduction seems necessary to some, but with traction or an abduction cast the patient must remain in bed. Against the plaster spica is argued its tendency to produce atrophy and shortening. The advocates of the walking caliper must have activity with freedom from weight-bearing. To combine the forms of treatment let us enumerate the desiderata:

1. Freedom from weight-bearing;
2. Activity to avoid atrophy;
3. Abduction at the hip.

All of these requirements are fulfilled by the peg leg cast. In addition, there is a gentle augmentation of the abduction to the maximum. Legg[18] shows that the gradual development of the cap type of deformity leads to limitation of abduction. Admitting that the disease is inevitably progressive and self-limited, it is hard to understand how this particular deformity could develop to an extreme degree if the femur were constantly in abduction during the active and convalescent stages.

One must concede that in the mild cases, and in some with great deformity but mild symptoms, a functional result is obtained with a minimum of treatment. Whatever his views as to etiology and prognosis, however, one must recognize the existence of a type of coxa plana with arresting symptoms of pain and limp. The patient must be relieved of these, even if the end result be no better. Here is a method which satisfies the requirements of symptomatic treatment, allows the patient immediate ambulation, and at the same time furnishes the affected femoral head an ideal environment for its partial restitution. Perhaps these same ideal conditions could be supplied with benefit in the milder case for a shorter length of time.

CASE 2. Adolescent coxa vara.

J. L., a colored boy of fourteen, was admitted to the Columbia Hospital with pain of the left hip and knee. Two years previously, without preceding injury or acute illness, he had begun to limp. Pain in the left hip had become so severe as to keep him in bed at times. After a year, pain appeared in the left knee. There had been no fever or sweats. Laboratory examination was entirely negative. The patient walked with difficulty with a marked adduction limp on the left. Abduction and external rotation at the left hip were abolished. Other hip motions were essentially normal. X-ray showed a typical adolescent coxa vara (Fig. 12). The patient was kept in bed with extension for ten days, with some relief of pain but only slight increase of abduction on the left. Then extension was obtained with a Hawley table; without anaesthesia twenty degrees of abduction were obtained on the left. By abducting the pelvis, an additional twenty degrees of apparent abduction were obtained. The right lower extremity was meanwhile in abduction of forty degrees and apparent abduction of twenty degrees. In this position a peg leg cast was applied. A week later the patient walked out of the hospital.

After three months the cast was removed. There was no pain or tenderness of the left hip. Motions at the left hip were: flexion forty-five degrees, abduction forty degrees, adduction ten degrees, rotation outward forty degrees, and rotation inward twenty degrees. (Note immediate free motion!) The pelvis had leveled itself in the process of walking and the apparent abduction had become real. X-ray (Fig. 13) showed slight improvement of the position of the head and neck with considerable local increase in density of the bone. Atrophy had diminished. A second cast was advised, but refused on superstitious grounds. The patient walked with crutches for two weeks and then returned to the usual activities of school and the negro quarter.

Examination one year later showed no increase in the deformity. There had been no pain since the removal of the cast. The limp returned a little only when the patient

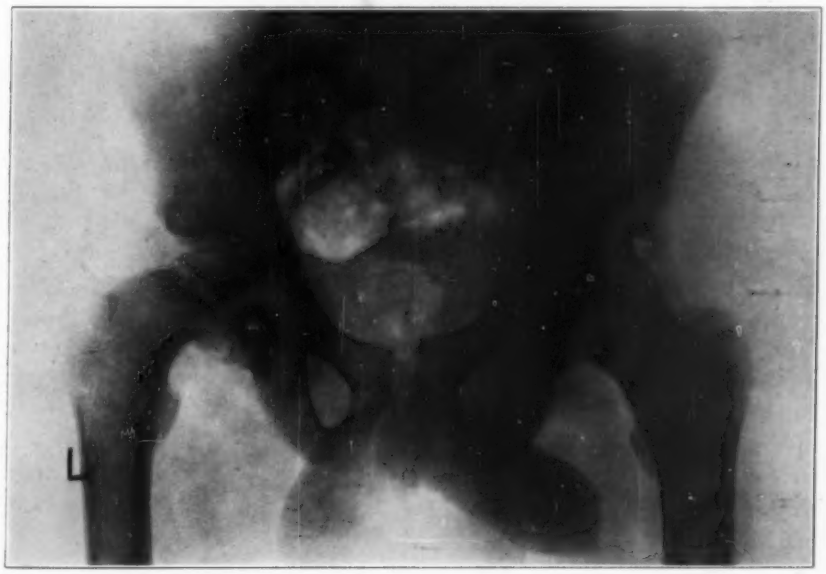

FIG. 12

Case 2. An x-ray at the time of admission showed a well developed adolescent coxa vara with rarefaction of the metaphysis of the neck. There was bowing of the neck and the femoral head had begun to slip. There was slight atrophy of the entire femur.

was tired. When he was examined he did not limp. Pain and tenderness were absent. X-ray (Fig. 14) showed complete subsidence of the disease process with the left hip in moderate coxa vara. Measurements were as follows:

	Right	*Left*
Length of lower extremity	101.0 cm.	100.0 cm.
Circumference of calf	35.0 cm.	35.0 cm.
Circumference of thigh	47.5 cm.	46.5 cm.
Hip Motions		
Flexion	80 degrees	80 degrees
Abduction	40 degrees	30 degrees
Adduction	35 degrees	35 degrees
Rotation outward	50 degrees	50 degrees
Rotation inward	35 degrees	15 degrees

In his comprehensive article on coxa vara published in 1907 Elmslie[19] divided the treatment into (1) prevention, (2) treatment during the progress of the deformity, (3) correction of deformity. He suggested that cases with indefinite x-ray findings but mild symptoms be treated with the hip in wide abduction on a double Jones abduction frame. During the stage of progress of deformity, he advocated abduction under anaesthesia

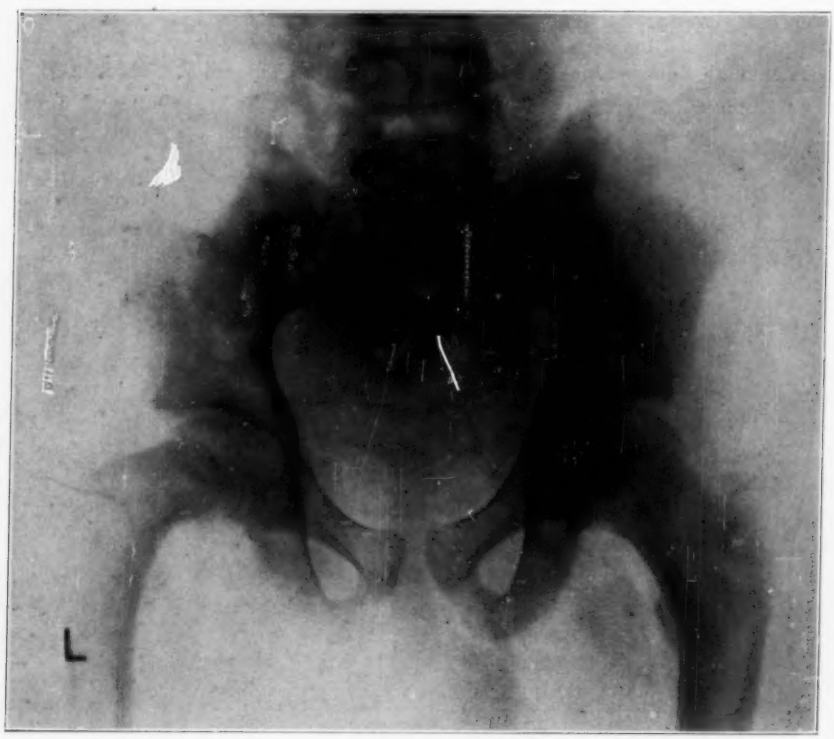

FIG. 13

Case 2. After three months in a peg leg cast the generalized atrophy had not increased. There was less rarefaction of the cervical metaphysis. The deformity had not increased, but rather improved.

FIG. 14

Case 2. After one year the density of the left femur is normal. There is a residual coxa vara, but function is good, and no osteotomy is required.

with fixation in this position for six to eight weeks. He followed this with a Thomas caliper for at least six months. For the correction of ancient deformity he suggested a transtrochanteric, wedge osteotomy. In the literature, one finds very little difference of opinion as to the desirability of operative correction of the well established deformity. A discussion of the type of operation has no place here. The peg leg cast would prove useful only as a postoperative measure and as such it is discussed later.

There is less agreement as to the treatment of the early case. The surgeon who believes in rest in abduction, will find that the peg leg cast satisfies the therapeutic requirements admirably.

In the management of the progressive stage of the deformity there has been a recent change. Forceful manipulation of the thigh into abduction under anaesthesia was advocated by Hoffa[20], Sprengel[21], Lorenz[22], Lange[12] and Whitman[14]. In the reduction of acute displacements of the proximal femoral epiphysis, there can be no doubt of the desirability of the Whitman method, as shown by Key[23] and Badgley[24].

But in the advanced adolescent cervical coxa vara or long-standing epiphyseal separation, forceful manipulation has recently been condemned. In the textbook of Jones and Lovett[17] it is stated that the rapid correction of adduction deformity is to be deprecated because of the likelihood of causing ankylosis. Key and Gaenslen* agree to this, and the former reports a case in which the opposite epiphysis was torn off in an ineffectual attempt to reduce the deformity. Lange[12] reports a case of non-union following manipulation. Camitz[25] shows the danger of injuring the structures about

*Personal communication.

the hip joint and likelihood of increasing the stiffness. He prefers to treat the symptoms conservatively, and later to do an osteotomy if necessary.

Waldenström[26] has recently reported a series of cases to show that forced reposition of slipped epiphyses frequently leads to ankylosis due to necrosis of joint cartilage. In twenty-four cases, treated with gentle abduction and traction followed by the use of crutches, there was no necrosis of the joint cartilage.

For the protection of the affected hip during the termination of the active stage, the peg leg cast is recommended. It combines the advantages of the abduction cast, the Thomas walking caliper, and the Bradford abduction splint. It is not removable, but in some cases this is an advantage rather than otherwise. Not only does it relieve the symptoms, free the joint from weight-bearing, and allow ambulation, but it exerts a gentle force to increase abduction.

CHRONIC HIP INFECTIONS

When prolonged immobilization of one hip is desirable, the peg leg cast is sometimes preferable to a brace. Two examples illustrate its use.

CASE 3. Septic arthritis of the left hip.

L. H., a white boy of nine years, was admitted to the Milwaukee Children's Hospital because of a progressively increasing limp of one year's duration. Following an osteomyelitis of the proximal end of the left femur, the hip joint had become involved without dislocation. When the patient was first seen, the femoral head had undergone complete destruction and the hip was ankylosed by fibrous tissue in flexion of thirty degrees, adduction of thirty degrees, and indifferent rotation. A sinus over the hip had been draining for six months, although no sequestra were present. For the following two years, the sinus drained intermittently and various types of mechanical treatment were tried. Traction confined the patient to a hospital bed and was used only at first. Ordinary casts held the hip in its initial position, but improved the adduction and flexion not at all. Under anaesthesia, the position could not be changed by the use of moderate force, and more than that was deemed inadvisable. So a peg leg cast was applied. Drainage diminished rapidly and under the influence of constant walking the position improved. The boy is now in his second cast. The hip is in flexion of ten degrees and abduction of ten degrees, which is considered a desirable position with three centimeters of shortening. While the hip is ankylosing, the position will be maintained by similar casts, and perhaps, later, a brace.

CASE 4. Tuberculosis of the hip.

J. P., a white girl of nine years, was admitted to the Milwaukee Children's Hospital with an active tuberculous lesion of the right hip of one year's duration. X-ray showed such extensive destruction of the joint that no hope was entertained of obtaining a movable joint. The right hip was fixed in adduction of twenty degrees and flexion of ten degrees, which in a girl with two centimeters of shortening was considered undesirable. After six months of traction on a Bradford frame with the usual general measures, the hip was in adduction of zero degrees. The general condition was good, so a peg leg cast was applied. When it was changed after six months, the right hip was in abduction of ten degrees, flexion of ten degrees. X-ray showed considerable increase in density about the joint with evidence of beginning bony union. The cast (Fig. 6), is in excessive abduction for illustrative purposes. The crutch was later changed to maintain abduction of ten degrees.

The peg leg cast is not recommended for most cases of tuberculosis of the hip. It might prove useful occasionally, however, when an adduction deformity is the result of the chronic joint infection. In such cases, the gentle abduction of peg leg walking is to be preferred to a sudden corrective force. It has proved even more effectual than the latter in reducing deformities with fibrous ankylosis.

POSTOPERATIVE USES

In cases requiring simple fixation of one lower extremity in abduction, the use of a peg leg cast contributes to the happiness of the patient. The activity has an undoubtedly beneficial effect on his general condition. Clinical experience has shown that the stiffness of fixation is much less than that following the use of an ordinary cast. Five cases illustrate the use of the peg leg cast in various conditions.

CASE 5. Osteotomy of the femur.

H. G., a white boy of nine years, developed multiple foci of osteomyelitis following a blister of the heel. The left hip joint became involved and subsequently dislocated. Three years later a subtrochanteric osteotomy was performed to alleviate the disabling limp. Instead of the ordinary spica, a peg leg cast was applied with the left hip in abduction of fifty degrees. The child was able to walk about during most of his eight weeks of fixation. When the cast was removed, motions at the left hip were: abduction fifty degrees, adduction zero degrees, rotation outward forty degrees, rotation inward fifteen degrees. The boy began the use of crutches at once, and now walks with only a moderate limp.

CASE 6. Pathological fracture of the femur.

H. M., a white male, ten years old, was admitted for an osteitis fibrosa of the upper third of the left femur with which there had been three pathological fractures in the preceding four years. The latest fracture had been on the day before admission. The cyst was curetted and by means of two wedge osteotomies the extreme bowing was corrected. The position was maintained by completely abducting the left lower extremity. A peg leg cast was applied and in this the patient walked about at home for ten weeks. On removal of the cast, union was firm with the fragments in normal alignment. There was good motion at the left hip.

CASE 7. Osteitis of the femoral neck.

R. H., a white boy of thirteen, was seen because of pain in the right hip and a limp of one and a half year's duration. X-ray showed a localized rarefaction of the right femoral neck. The lesion was curetted through a tunnel of the greater trochanter and neck. Cultures were negative and microscopic examination showed the lesion to be a proliferative osteitis. An ordinary abduction spica was worn for one month. Then, as a protection to the weakened femoral neck, a peg leg cast was used for a second month and the patient allowed to walk. He emerged with good hip motion. The recovery was complete.

CASE 8. Subluxation of the right hip.

J. S., a four-year-old white boy, began to walk normally at fifteen months. Half a year later the parents began to notice a slight limp which became progressively worse. X-ray and clinical examination revealed a subluxation of the right hip with a shallow acetabulum and marked anteversion of the femoral neck. Under general anaesthetic the subluxation was reduced by traction and manipulation. Internal rotation of the femur was necessary to maintain the reduction, and abduction of forty degrees was secured. In this position a peg leg cast was applied. The child soon learned to walk very well.

CASE 9. Subluxation of the left hip.

K. L., a male child of twenty-six months, was admitted because of a limp which had been present since he had begun to walk at fifteen months. Clinical and x-ray examination revealed a subluxation of the left hip. The limp was only moderate. Under general anaesthesia the left femoral head slipped easily in and out of the acetabulum. When it was in, only thirty degrees of abduction could be obtained. With the femur rotated sharply inward and abducted, a single spica was applied. The first cast was removed at six weeks, and as an experiment a peg leg cast (Fig. 1) was applied without anaesthesia. The child learned to walk in spite of his age.

If activity is desirable in congenital dislocations and subluxations of the hip, this technique would seem to solve the problem of walking in older children. It should be particularly useful following open reductions where limitation of motion is often a serious complication. The crutch could be used with either the "frog" position or that of internal rotation, in unilateral cases.

CONCLUSIONS

1. The peg leg cast is recommended for the ambulatory management of many hip abnormalities in children.
2. It is desirable when simple fixation in abduction is sought, and has been used to advantage postoperatively.
3. In the treatment of chronic hip infections with shortening and vicious adduction, it is the method of choice for the correction of position and immobilization of the hip.
4. It is specifically indicated during the active stages of coxa plana and coxa vara.

It is my pleasure to thank Dr. F. J. Gaenslen and Dr. H. C. Schumm for permission to report several cases from their files.

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THE MODIFIED LOOP OPERATION FOR THE RELIEF OF PARALYTIC EQUINOVALGUS*

BY ARMITAGE WHITMAN, M.D., F.A.C.S., NEW YORK, N.Y.

The operation which I shall describe is applicable to but a small group of cases, — those in which as a result of anterior poliomyelitis the tibialis anticus and posticus, or the tibialis anticus alone, are paralyzed.

The condition which results is known as paralytic equinovalgus or paralytic flat-foot. The deformity results from two causes: first, the loss of supporting power of the muscles themselves; and second, the unopposed pull of the peronei muscles. This constant deforming factor results in an outward deviation of the foot upon the mid-line of the leg, in such a manner that eventually the extensor communis digitorum and extensor proprius hallucis muscles become displaced to the outer side of the mid-line and act in conjunction with the peronei as abductors of the foot upon the leg.

The operations hitherto at command have been of two types. The first is any form of operation directed at the correction of deformity and maintenance of stability by some form of arthrodesis, — subastragalar arthrodesis, triple arthrodesis, the Davis, Hibbs, Ryerson or Hoke operations. Excellent as any of these operations may be, their ultimate success depends upon the maintenance of the stability and original diameter of the tibiofibular mortise. Once that mortise widens or the lateral ligaments of the ankle joint begin to stretch, a certain degree of lateral instability or deformity must result. This ultimate possibility is of course greatly enhanced by a constant, active, unopposed deforming factor, — in the cases under discussion, the peronei muscles.

The second operation was that devised by my father and called by him the loop operation.[1] The objections to the operation were that it was prolonged, difficult, and, for the average operator, complicated There was occasionally some interference with the blood supply due to the considerable dissection. The most serious objection was that the operation was too successful, sometimes converting an extreme valgus into a mild varus deformity. This was always successfully corrected by some form of arthrodesis, but naturally one is always anxious to avoid a second operation.

The present operation was devised to combine the desirable features of the two types described. The subastragalar joint is exposed through an incision on the inner border of the foot, the tibialis posticus tendon being drawn aside. With a wide chisel the apposing cartilaginous surfaces of the astragalus and os calcis are removed, and in cases of severe deformity enough additional bone to bring the os calcis into direct vertical alignment

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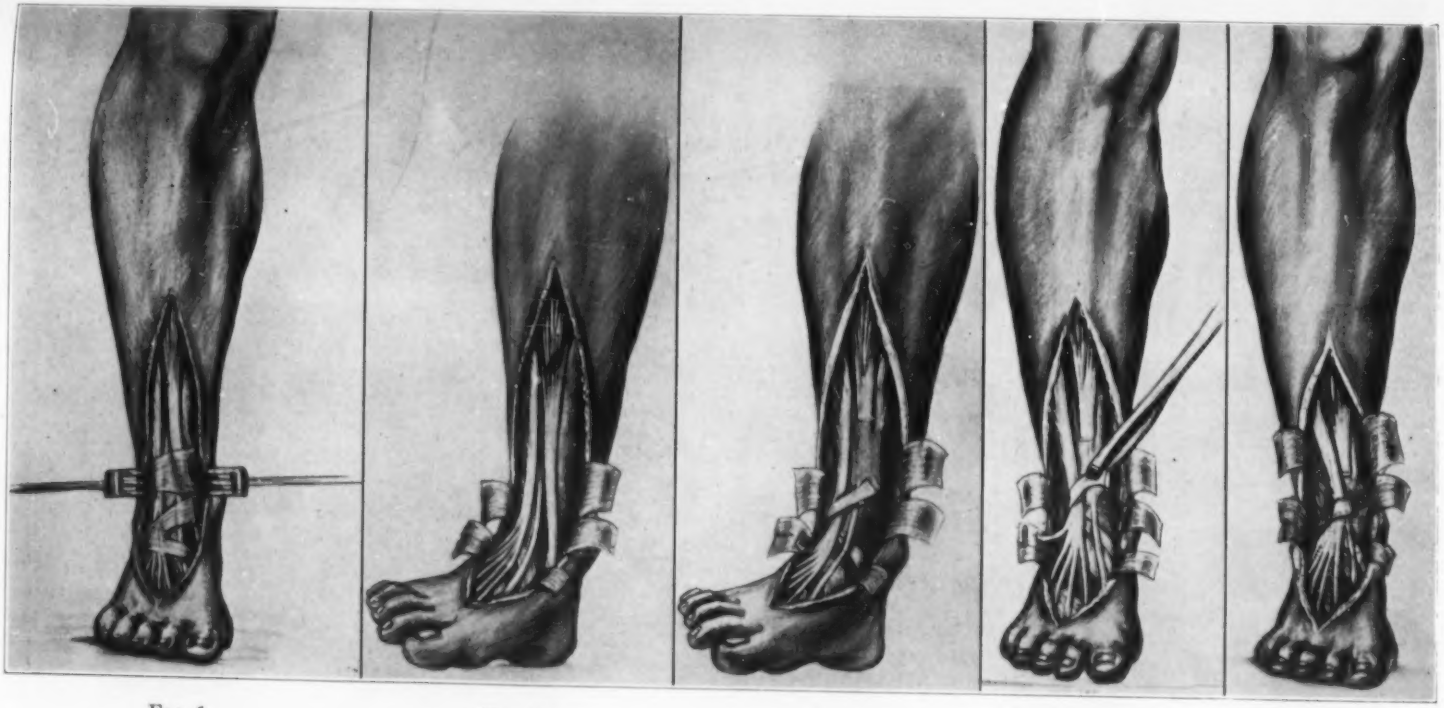

FIG. 1

Showing the arrangement of the tendons in front of the ankle joint.

FIG. 2

The tibialis anticus being paralyzed, the extensor communis digitorum and peroneus tertius dorsiflex the foot into an attitude of marked valgus.

FIG. 3

The tendon of the tibialis anticus is divided. The tendon of the peroneus tertius is divided. The extensor communis digitorum is dissected up and the tendon of the tibialis anticus passed beneath it.

FIG. 4

The tibialis anticus tendon drawing the extensor communis digitorum toward the midline.

FIG. 5

The peroneus tertius is sewed to the extensor communis digitorum. The tibialis anticus tendon is buried subperiosteally in the tibia, holding the extensor tendons displaced inward.

with the tibia. The cartilage is also removed from the apposing surfaces of the head of the astragalus and the scaphoid, and if necessary as much bone as may be indicated to restore the arch of the foot. Any bone chips available are placed between the surfaces. The wound is closed.

An anterior incision is then made, running from about two inches above the annular ligament down to the insertion of the tibialis anticus. The annular ligament is divided. The tendon of the tibialis anticus is divided at its junction with the muscular portion and drawn out of the sheath. The extensor proprius hallucis and extensor communis digitorum are then dissected up from about an inch proximal to the base of the toes to above the annular ligament. The peroneus tertius is divided and sewed to the adjacent extensor tendon. The tendon of the tibialis anticus is passed beneath the extensors, looped around them, and drawn back so as to hold them in the mid-line. The anterior surface of the tibia is exposed, and an oblique cut made in it, extending upward and inward from just above the epiphyseal line. The periosteum is stripped back, and a shallow bed prepared for the tendon with a gouge. The tendon is then scarified. Interrupted chromic sutures are then passed in through the periosteum, then through the tendon, then looped around it and passed through it again, and finally cut through the periosteum. These sutures are tied simultaneously, and hold the tendon completely buried subperiosteally. The greatest care must be taken to see that the tendon is under sufficient tension to hold the extensor tendons slightly to the inner side of the mid-line, and at the same time sufficiently slack to allow at least ten degrees of plantar flexion. This combination is achieved by varying the angle at which the tendon is inserted in the bone.

The wound is then closed in layers and a light, carefully molded plaster

FIG. 6

Case 1, B.H. Pre-operative view, both feet.

FIG. 7

Case 1, B.H. Post-operative.

FIG. 8

Case 1, B.H. Post-operative,—mesial view.

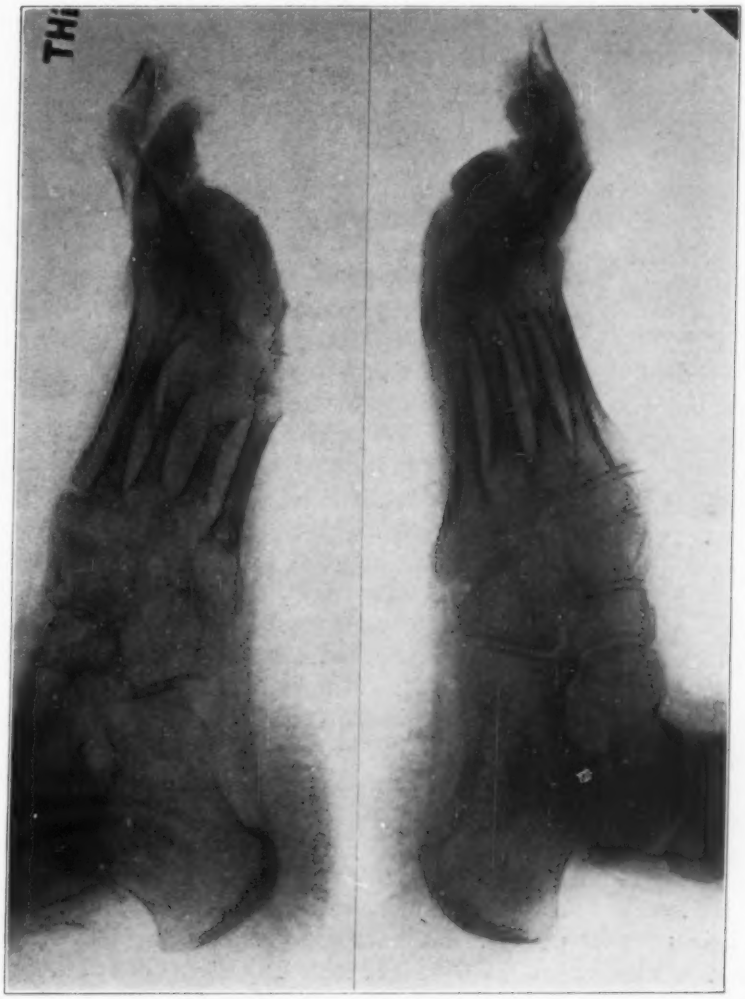

FIG. 9

Case 1, B.H. Postoperative x-ray, both feet.

applied, holding the foot at a right angle, and the valgus deformity corrected. The plaster may be molded to restore the arch of the foot, but the os calcis must not be displaced inward on the tibia. The foot is held elevated for several days and strictest supervision exercised over the circulation.

This plaster is left in place for three weeks. It is then removed, the wound is dressed, and a so called "walking plaster" applied. If the original position was not exactly correct, it may be rectified as desired at this time. When the plaster has hardened, a protective leather covering or "plaster shoe" is applied upon which the patient is allowed to walk about, provided walking causes him no pain. Pain is regarded as a contra-

FIG. 10

Case 6, P. V. Showing the patient bearing his full weight upon the operated foot.

indication to weight-bearing. This plaster is worn for ten weeks, of course in the meantime being changed if necessary. Three months after operation, if bony ankylosis has occurred, as it usually has, a Whitman weak-foot brace is applied, and the patient allowed to walk with it in an ordinary shoe, which has been raised upon the inner border one-quarter inch, heel and sole. By the end of six months all support may, as a rule, be discarded.

The operation has been performed eight times on seven patients. The duration of time since the operation varies from forty-four to seven months, the average being twenty-one and two-tenths months. There have been no deaths and no infections. In one case there was sloughing of the skin on both sides of the anterior incision. This was due to interference with the circulation from a too tightly applied plaster. The plaster was split the day following operation, but the underlying circular bandage of sheet wadding was not divided. When it was, the condition promptly cleared up.

One patient — the bilateral case in which each foot was operated upon — shows too much varus on the first foot, and in consequence slightly too much valgus on the second. She, however, is satisfied. Another bilateral case is returning this summer at his own request for the operation to be performed upon the second foot. All of the patients are satisfied with the results. This is a fact of greater importance than it would ordinarily be in a report of any operative procedure. One must remember that after all has been said and done in regard to theory, in practice the foot belongs to the patient. He is the one who has to use it, and thus his estimate of his own condition must be more important than that of anyone else.

[1]Whitman, Royal: Orthopaedic Surgery. Ed. 9. Philadelphia, Lea & Febiger, p. 912, 1930.

THE MACROPHAGE IN ABSORPTION FROM THE SYNOVIAL CAVITY*

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The synovial membrane is concerned with: (1) the production of synovial fluid for lubrication of the articular surfaces and for nourishment of the cartilages, and (2) absorption from the cavity of the joint.

Absorption was first studied by Mosengeil (1876) who injected Chinese ink into joints and demonstrated that motion and massage aided absorption. Braun, Jaffé, and Kroh made somewhat similar observations. More recently, Key[17] made his extensive observations on absorption, and pointed out that in addition to the synovial cells there are a few macrophages, leucocytes, and small round cells scattered here and there in the loose portions of the surface of the joint. These macrophage cells also were briefly mentioned by Seeliger as being present in the synovial membrane and they were found in pathologic specimens by Permar and by Shands. Franceschini noted the reticular structure of the synovial membrane and the large number of macrophages, and classified the synovial membrane as a "reticulohistiocytic" structure. Key[18] also found that ninety per cent. of the cells found in normal synovial fluid were macrophages.

This study was undertaken to learn more of the processes involved in absorption, with particular attention to the part played by the macrophage.

METHOD OF STUDY

All of the experimental work was done on dogs, which were in every instance under deep surgical anaesthesia throughout the experiments.

The apparatus used consisted of an air-tight box containing a carbon light for heating, connected with a rheostat, a thermometer, and two fifty-cubic-centimeter glass containers which could be read through small glass windows. This apparatus permitted of the introduction of solutions into the synovial cavities under identical conditions. All solutions were introduced by gravity from a height of thirty centimeters through 18-gauge needles. The fluid medium was Ringer-Locke's solution, which was kept at body temperature.

With the animals anaesthetized, and with the apparatus described, it was possible to study relative absorption from the two synovial cavities without such variable influences as the amount of pressure exerted in introducing the dyes, exercise, and massage. These factors would have

*From the Division of Experimental Surgery and Pathology of The Mayo Foundation.

altered the rate or methods of absorption. The technique used proved satisfactory.

The following solutions were introduced directly into the synovial cavity of the knee: two-per-cent. solutions of Berlin blue and trypan blue which are both colloids; ultramarine blue, a fine suspensoid; and India ink, a coarse suspensoid. Gross and histologic studies were made of the synovial membrane and fluids, of the periarticular structures, of lymph and blood channels, and of various organs of the body.

Specimens were placed in formalin, in Zenker's fluid, and in solution of acetic acid and corrosive sublimate. The last mentioned medium was found to give the best results. All sections were stained with acid-carmine, which gave a splendid contrast to the various substances injected.

RESULTS OF EXPERIMENTS

The experiments on the mechanism of absorption and their results will be considered as follows: (1) the variability in absorption of different materials; (2) the relation of the histologic features of synovial membrane to absorption; (3) the fate of absorbed material when it penetrates into the blood stream or into the lymphatic channels; and (4) the specific rôle of the macrophage in absorption.

It was noted that certain substances were absorbed with much greater ease than others. Ease of absorption apparently was in direct relationship to the nature of the injected material,—whether it was a colloid or a suspensoid. Experiment 1 is illustrative of the type which led to this conclusion.

Experiment 1. — The dog was placed under deep ether anaesthesia. The abdomen was so opened as to give good exposure of the pelvic and lumbar regions. The skin over the legs and knees was incised to permit observation of the subcutaneous tissues, particularly along the course of the femoral vessels. Trypan blue, a colloid, was injected into the synovial cavity of the left knee and Higgins' India ink, a suspensoid, into the right. Both materials were allowed to flow in for a period of four hours.

After fifty minutes the trypan blue was seen ascending in the deep lymphatics about the left iliac artery and entering a lumbar lymph node. This absorption of dye continued readily during the entire period of observation.

In contrast to this, there was no evidence of any India ink in any of the lymph channels or nodes of the right leg during the entire period. Dissection corroborated these observations. The lymph channels filled with trypan blue were seen to originate from the posterior part of the synovial membrane, and more originated on the medial than on the lateral aspect. The channels then followed the deep vessels, some going to the deep inguinal nodes, but most of them coursing along the iliac artery, and circling about it, to empty into the lumbar nodes. There was no staining of the popliteal node.

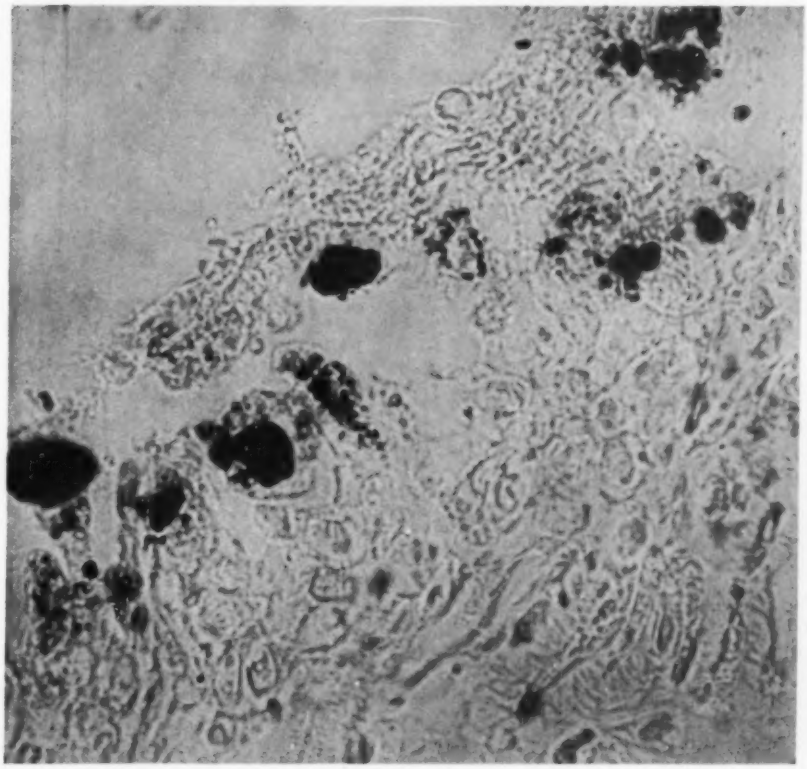

FIG. 1

An unstained section of synovial membrane. Macrophages are filled with dye that was injected into the articular cavity.

Experiment 2. — This experiment is similar to Experiment 1, except that ultramarine blue was used in the right knee in place of India ink. For injection into the left knee trypan blue was employed. Ultramarine blue is a suspensoid but is composed of finer granules than India ink. Ultramarine blue was absorbed by the lymphatics; the lymphatic channels of both legs were filled in the same time (fifty minutes). Dissection of this animal substantiated the observations of Experiment 1, relative to lymphatic absorption. Again there was no staining of the popliteal node. Thus, there is definite variability in the absorption of these different materials from the synovial cavities of the knee joints under identical conditions.

The relation of the histologic elements of synovial membrane to absorption. — In searching for an explanation of this selective absorption of injected substances, microscopic sections of the synovial membrane were examined. Here it was found that in addition to the usual type of "fixed" synovial membrane cell there was another markedly phagocytic cell, later definitely identified as the macrophage. Figure 1 represents an unstained section of synovial membrane which lined the cavity into which trypan blue had been injected and illustrates definitely the extent to which the suspen-

soid particles of the dye were engulfed by the macrophages; the fixed cells remained clear.

In Figure 2*a* is seen another section of the membrane from the knee into which trypan blue had been injected. There has been phagocytosis by the macrophages, diffusion through the membrane of the non-granular elements, and marked staining of the cellular elements of the synovial membrane and connective tissue and even of the intravascular blood cells. Thus the diffusible, very fine colloidal material passes through to the deeper structures and can be demonstrated to stain the erythrocytes. I believe the large macrophage in this section is contained in a lymphatic channel, for reasons to be given later.

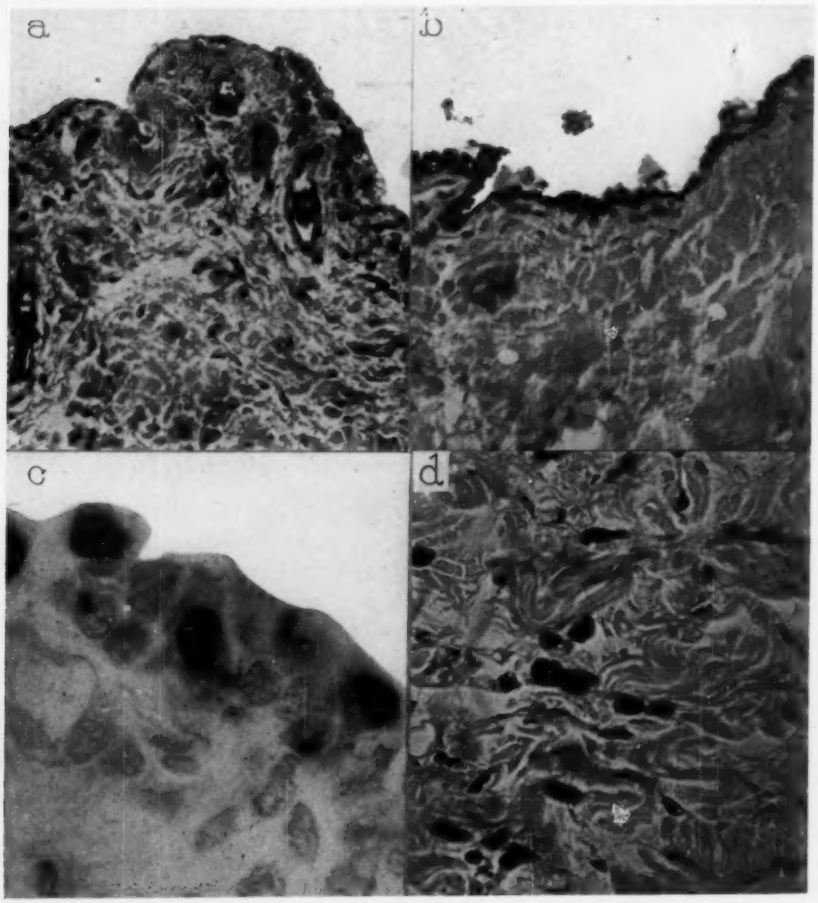

FIG. 2

Sections of synovial tissue after injection of various substances into the articular cavity: *a*, in the synovial membrane there has been phagocytosis of coarse granules of trypan blue and diffusion of fluid and finely colloidal particles four hours after injection; *b*, the synovial membrane has remained impermeable four hours after injection of India ink; *c*, synovial membrane seven days after injection of trypan blue, and *d*, subsynovial tissue seven days after injection of trypan blue.

Figure 2*b* represents the membrane from the cavity which contained India ink and the contrast with Figure 2*a* is marked. There is no evidence of the presence of the ink beneath the membrane, either within cells or as diffuse particles. The membrane has proved an effective barrier to the passage of this particular foreign material for the period of the study.

The fate of absorbed material. — It has been demonstrated that there is marked variability in absorption of injected material from the synovial cavity and this can be explained by the histologic structure of the synovial membrane. What, then, is the fate of this injected material?

Penetration of the foreign material into the blood stream is illustrated in Figure 2*a*. It demonstrates diffusion of the fluid and colloid portions of the dye through the synovial membrane and staining of the deeper tissues. The material is seen to have penetrated into the veins and to have stained the intravascular blood cells. This is in contradistinction to the granular elements, which were engulfed by the macrophages. There was not any evidence of penetration of the granular elements into the blood stream in any section studied. It may be concluded, therefore, that only fluid and finely colloidal material penetrated into the blood stream during the period of observation.

Penetration of the foreign material into the lymphatic system was seen in the experiments reviewed. By injecting trypan blue and ultramarine blue into the synovial cavities of the knee joints of dogs in which the lymph channels and lymph nodes had been exposed, actual transportation of the material by the lymphatic system could be observed. The colored lymph was observed to ascend through the lymph channels to the deep inguinal and lumbar nodes.

Textbooks on anatomy state that the lymphatic channels from the knee joint drain to the popliteal lymph node. This was not demonstrated in any of the experiments.

Although the lymphatic channels undoubtedly transport the fluid and finely colloid material, as do the veins, the lymphatic channels alone seem to transport the particulate material which has been engulfed by macrophages.

The specific rôle of the macrophage in absorption. — Since the macrophage is motile, it is able to find its way into the underlying connective tissue. Here it may remain for a considerable period. Figure 2*c* is a section of synovial membrane taken from a joint seven days after injection of trypan blue into the cavity. The dye-filled macrophages are plainly seen in the membrane proper and can be seen in the connective tissue immediately underlying the membrane. The section shown in Figure 2*d* was taken from the deeper connective tissue, and numerous macrophages are present. The various shapes and sizes of these dye-filled cells may be noted. Some of them seem to be indistinguishable, morphologically, from ordinary connective-tissue fibroblasts.

A fresh preparation of the synovial fluid of the dog from which the section shown in Figure 2*d* was taken, revealed active, motile macrophages

containing granules of dye. Key[17] has reported the presence of dye in the synovial cavity many days after injection.

The macrophages not only remain in the synovial fluid and penetrate the deeper tissues by amoebic motion but they enter the lymphatic channels and ascend in them. In Experiment 2 the passage of the dye from the synovial cavities to the lumbar nodes was observed. A cannula was introduced into the ascending lymphatic channels and drops of lymph were examined when fresh. The actively motile macrophages were easily identified and all were filled with dye. There was a preponderant number of lymphocytes present, none of which contained any dye, which emphasizes again the specificity of one cell, the macrophage, in particulate absorption.

Occasionally a large dye-filled macrophage is seen in a structure which appears to be a lymph channel. The difficulty of distinguishing between

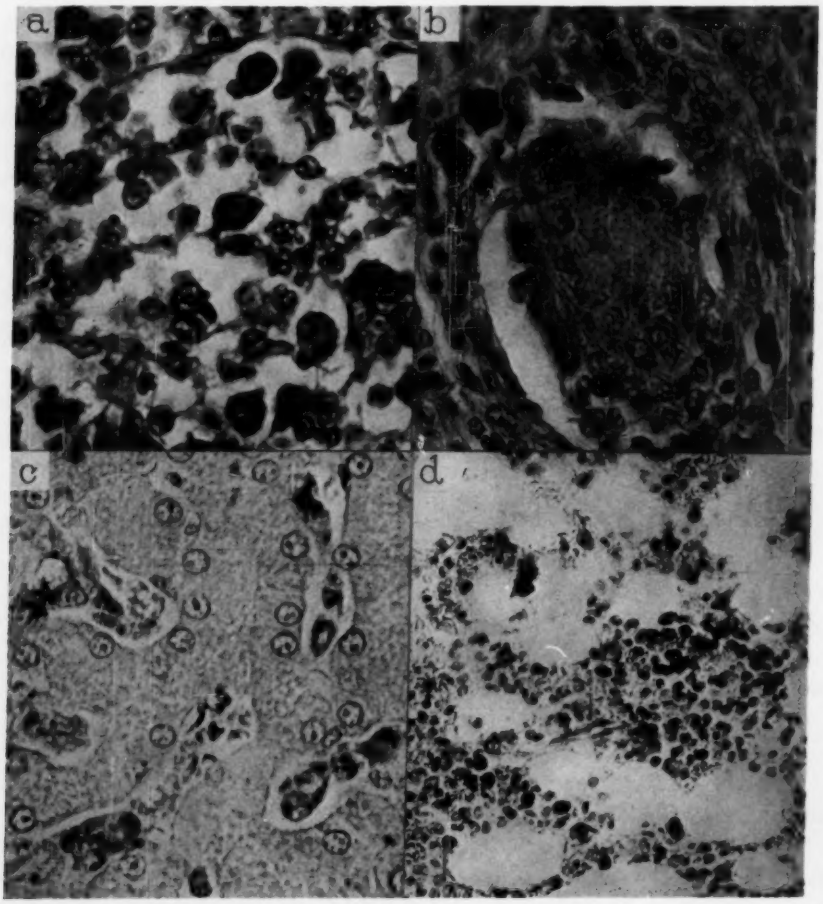

FIG. 3

Cells filled with dye in organs distant from the joints which had been the sites of injection: *a*, macrophages in a lumbar lymph node; *b*, macrophages in the spleen; *c*, Kupffer cells in the liver; and *d*, macrophages in bone marrow.

venules and small lymphatic vessels is acknowledged; but in these sections, whenever intravascular macrophages are seen, they are not associated with erythrocytes as they presumably would be if they were in venules; and conversely macrophages are not seen in structures filled with erythrocytes. The intravascular cells are often stained with the finely colloidal stain, but granules have not been seen in a venule, either free or intracellular. Furthermore, granules were not found free in the lymphatic channels; they were present only in macrophages. This agrees with the observations which Permar made on the lung. These observations lead to the conclusion that macrophages are carried to the general circulation only through the lymphatic apparatus.

Granules seem to be carried into the synovial cavity in macrophages. One dog was given five injections of five cubic centimeters of trypan blue (two per cent.) into the jugular vein, over a period of two weeks. Three days after the last injection a fresh preparation of synovial fluid revealed the granules of trypan blue in the macrophages, but none was found free in the fluid.

Thus far the important part played by the macrophages in phagocytosing granules and transporting them into the deeper structures of the joint and through the lymphatics to the general organism has been seen. In order to trace their distribution in the body, ultramarine blue was injected into the synovial cavities and portions of various organs were removed thirty minutes later.

Figures 3*a*, 3*b* and 3*c* represent sections from an animal used in such an experiment. Figure 3*a* is a section of a lumbar node and the dye-filled macrophages make a vivid contrast with the carmine-stained lymphoid tissue. Figure 3*b* illustrates a group of these cells in the spleen and Figure 3*c* demonstrates them in the liver. Figure 3*d* represents a section of bone marrow. These structures are the main components of the reticulo-endothelial system, in which the macrophage plays a significant part.

COMMENT ON RESULTS

In spite of the almost invariable presence of focal infection, joints seem to maintain their integrity to a high degree. Yet, to and from the cavities of the joints, there is constantly a chemical flux and flow of material from the blood stream. At first thought one might consider the synovial membrane to be rather passive and readily permeable to dye and other extraneous material, but from this study it would seem that the specificity of the synovial membrane in maintaining articular integrity should be accorded more respect.

The experimental relationship between the synovial cavities and the body as a whole may explain some of the facts noted by clinicians in cases of arthritis. Some who have described the protean manifestations of this disease are Bannatyne, Wohlmann and Blaxall, Felty, Foster, Goldthwait, Hench,[11, 12] Herringham, Hirsch, Marshall, McCrae, Osler, Pemberton, Spriggs, Stengel, Still, and Von Mueller.

Hench[12] wrote: "The symptoms of chronic infectious arthritis in its milder and simpler forms are generally confined to muscles and joints. In its more severe, progressive forms, however, chronic infectious arthritis is quite protean in nature. It might be defined as a disease which is systemic in distribution, with its major manifestation in articular and periarticular structures, but with important manifestations which may be apparent in other structures and systems of the body."

Examples of the foregoing are numerous. Accompanying secondary anaemia at times has been so profound as seriously to suggest that it is of the pernicious type. Marked loss of weight and anorexia, anaemia, and gastric achlorhydria often cause one to suspect a malignant condition. Accompanying myocardial involvement may predominate in the clinical picture. Associated splenomegaly with progressive anaemia has, on occasion, raised the issue as to the possibility that there is present an accompanying condition of splenic anaemia of the Banti type, or one of the other types of splenic anaemia. Focal nephritis or definite deficiency in carbohydrate metabolism may be a complication. Hyperthyroidism must be excluded in certain cases with tachycardia, loss of weight, sweating, and tremor.

The macrophage cells of the synovial membrane undoubtedly are related to the macrophage cells of other situations in the body, and through the relation of these cells the synovial membrane apparently has a definite connection with the remainder of the body, particularly with the reticulo-endothelial system. This is of especial clinical significance. In Still's disease, which occurs usually in children with infectious arthritis, but not uncommonly in adults, generalized lymphadenopathy and splenomegaly, associated at times with hepatomegaly and anaemia probably of bone-marrow origin, are present. It is interesting to conjecture, therefore, on the possible rôle of the macrophage cells in disseminating, at times, uncontrolled infection. The fact that there is such a definite reticulo-endothelial response in the more severe cases of arthritis would suggest that particulate substances were being brought to them from the joints (as well as perhaps from a primary focus).

The rôle of the macrophage in absorption from the synovial cavity may serve to explain certain of the results of the bacteriologic study of arthritis. It has been noted repeatedly that cultures of the synovial fluid from patients afflicted with the infectious type of arthritis are negative.

Thus Ashcroft, Cunningham and McMurray made a study of fifty cases of arthritis deformans, and of their positive cultures only one was obtained from the synovial fluid; all the others were obtained from the synovial membrane or articular cartilage and bone. Richards attempted cultures of joints in fifty-four cases and obtained but four positive cultures. These were taken during an acute exacerbation. An attempt was made to obtain this fluid from the inflamed periarticular tissues as well as from the articular cavity. Margolis and Dorsey made cultures from epiphyseal marrow, synovial membrane, articular cartilage, and synovial fluid in cases

of chronic infectious arthritis. Positive cultures were obtained from all tissues, but cultures from the synovial fluid in all instances were negative.

The bacteriologic studies and the experimental work here recorded would indicate that the synovial membrane may harbor infective organisms and act as a focus for further involvement. Clinically, this has been found true, and Heyman and Swett have urged complete synovectomy of chronically infected joints and reported excellent results following such operations.

The lymph nodes also have been shown to harbor infective organisms. Thus Forkner, Shands and Poston obtained positive cultures from synovial fluid in only fourteen of sixty-three cases (22 per cent.), whereas they obtained organisms from ten of twenty-one cultures (48 per cent.) from regional lymph nodes. Gibson forcefully brought this fact to attention and expressed surprise that following Rosenow's[29] work in 1914 little effort had been expended in studying the part played by infected nodes in the continuance of arthritic disease. In the discussion of Gibson's paper, Osgood, Baer, and Allison all were in accord with his view.

There is no recorded case of a positive culture having been obtained from the popliteal lymph nodes. Rosenow[28] stated that after much experimentation he ceased attempting to obtain organisms from this node. This supports the observation of the unstained popliteal node in the experiments here recorded and suggests that the drainage of the knee joint is not to the popliteal node, as generally described, but to the deeper inguinal and femoral nodes.

One might theorize on the rôle of the macrophage in prevention and treatment of infection of the joint, on absorption of toxic and infectious materials from the joints, on introduction of such material into the cavities of the joints, and especially in regard to its function in the maintenance of sterile fluid in the joint, even in the presence of marked periarticular infection.

Two hypotheses predominate regarding the cause of arthritis of the so called chronic deforming or chronic infectious type: that it is the result of toxic products only, and that it is the result of actual bacterial invasion. If, in the light of these studies, one substitutes toxins for solutions and bacteria for particulate material, it would seem that the synovial membrane possesses a different mechanism of defense and offense for the two substances. It suggests the possibility that the fate of bacteria is different from the fate of toxins, that whereas the latter may penetrate into both blood and lymph vessels and may be absorbed by them, bacteria may be cared for entirely by the macrophages, the special function of which would seem to be to carry them to and through the lymphatic system.

These studies may prove of importance from the therapeutic standpoint. Churchman has made extensive observations on the action of gentian violet on articular structures and has advocated intra-articular injection of gentian violet in the treatment of many inflammatory conditions of the joints. He has demonstrated the presence of this dye in the synovial membrane but his studies on the histology of the dye-stained

synovial membrane and on the fate of injected dye are meager. Variable success has attended this form of treatment. Such therapeutic attempts should take into account the phenomena of absorption.

CONCLUSIONS

1. The synovial membrane has specificity in its reaction to intra-articular material, as here illustrated by dyes.

2. This specificity is determined by distinguishing two distinct types of cells in the synovial membrane. The secretory cells, preponderantly present, maintain an absolute integrity against all but finely colloidal solutions. The particulate substances seem to be engulfed entirely by the macrophages.

3. The fluid and colloid elements are transported both through blood and lymphatic channels, and are diffused throughout the entire body.

4. The dye-filled macrophages may remain for some time in the periarticular structures or may be transported, seemingly by the lymphatic structures only, to various structures of the body, chiefly members of the reticulo-endothelial system. These dye-filled macrophages are found largely in lymph nodes, liver, spleen, and bone marrow.

5. Apparently the lymphatic channels of the synovial cavity of the knee drain directly to the inguinal and lumbar nodes, rather than to the popliteal nodes, as generally described.

6. These macrophages may afford a key to the clearer understanding of the behavior of the lymph node, liver, spleen, and bone marrow in the presence of arthritis.

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THE AMBULATORY TREATMENT OF FRACTURES OF THE LOWER EXTREMITY

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The method to be described in the treatment of fractures of the lower extremity is the one devised by Dr. Lorenz Böhler and put into practice by him at the Unfall Arbeiter Krankenhaus, Vienna, Austria. It is especially applicable to fractures of the foot and ankle and less particularly so to fractures of the lower leg.

The cases in which we have used this method of treatment on the Fracture Service at the Worcester City Hospital have been limited with one exception to fractures about the ankle joint, the foot, and the lower third of the lower extremity. In general, our routine has been as follows: first, reduction of the fracture as soon as possible under a general or local anaesthetic; second, fixation with plaster-of-Paris splint. If little or no external traumatization is present the plaster-of-Paris is applied without padding; otherwise, sheet wadding is used. The patient is then put to bed with the foot elevated for twenty-four hours. A check-up x-ray is then taken. If position is satisfactory an iron walking heel is then incorporated into the plaster-of-Paris cast and as soon as the cast is hard the patient is allowed to bear weight on the fractured limb with or without support depending upon his timidity.

The iron heel (See Figure 1) consists of an iron bar twenty-six inches long, one-eighth of an inch thick, and three-quarters of an inch wide, to which are riveted at both ends two cross pieces, each five inches long, one-quarter of an inch wide, and one-sixteenth of an inch thick.

FIG. 1

This bar when ready to use is bent in a U-shaped manner (See Figure 2), and is applied to the contour of the cast in the axis of the leg in such a manner that it extends one inch below the plantar surface of the cast (See Figure 3). The cross pieces are bent to grip the cast in its circumference and are held in position by an assistant while plaster-of-Paris bandage is wrapped about them. Figures 4, 5, and 6 show the heel in position from the mediolateral, lateromedial, and anteroposterior views respectively.

We have employed these methods in a large number of cases and we have had uniformly satisfactory results.

The patients are up and about, bearing weight on the injured member usually on the third day, and without support of cane or crutch. Should swelling and discoloration of the toes develop, it would be necessary to remove the cast immediately. On the fifth day a third x-ray is taken and, if fragments are still satisfactorily retained, the patient is now ready for discharge to Out-Patient or home care.

FIG. 2

The patient himself is usually very well pleased with his ability to be up and about and able to walk without pain and, in cases where the occupation of the injured is not laborious, he can at once return to work.

The follow-up care is essentially unchanged. Depending upon the amount of damage done, the cast is removed in from four to six weeks. One of the striking facts noted on removal of the cast is the lack of atrophy of the tissues and the large amount of voluntary motion in the injured member. In most of our cases, on removal of the cast, the patient has been able to put on shoe and stocking and walk immediately with no pain and with comparatively little limp.

A brief summary of a few of these cases follows:

CASE 1: Mrs. M. A. T., age forty-eight, occupation housewife. Hospital number A80228. Admitted September 18, 1929, fracture of both malleoli with marked inward and backward displacement of the foot. Immediate reduction and fixation with plaster-

FIG. 3

FIG. 4

of-Paris cast. Check-up x-ray on September 19 shows good reduction. On September 22, iron heel was applied to cast and, when cast was hard, patient was permitted to be up and about ward and was entirely free from pain. She was discharged to her home on September 27. At home she was able to do most of her ordinary household work. On the fifty-sixth day after the injury the cast was removed and motion of the ankler joint was found to be somewhat better than half normal range in all directions. She was able to walk about house with shoe and stocking on, with little or no limp; and two weeks later she was able to go out-of-doors, do her shopping, and complained only that the ankle tired somewhat after long walking.

Case 2: Mrs. B. T. S., age sixty years. Hospital number A80946. Admitted October 21, 1929, fracture of both malleoli and inward displacement of foot. Also fracture of the base of the fifth metatarsal. Arthritic changes were present. Immediate reduction and fixation with plaster-of-Paris. Check-up x-ray on October 22 was satisfactory. On October 23, ambulatory heel was applied and patient was immediately allowed to walk about the ward and was free from pain. On October 26, check-up x-ray was satisfactory and a few days later patient was discharged to her home. December 18, 1929, cast was removed and patient was found to have firm union, no atrophy, and almost full range of motion in the ankle joint. She was able to walk without cane or crutch. One hundred days after her injury she stated that she felt practically no effects from her injury.

Case 3: Miss V. K., age twenty-four years. Hospital number A82024. Admitted December 14, 1929. Fracture of the internal malleolus with outward displacement of the foot. Reduction and fixation with plaster-of-Paris cast. Check-up x-ray on December 15 was satisfactory. On December 16, iron walking heel was applied and patient was up and about the ward. Check-up x-ray on December 18 was satisfactory and patient was discharged. From the date of her discharge this patient attended theaters, social functions, and church regularly, with no discomfort. Twenty-eight days after injury cast was removed. Union was found to be firm and motion of the ankle joint was normal.

Case 4: Mrs. E. C., age fifty-two years. Hospital number A80175. Admitted September 16, 1929. Fracture of both malleoli with complete inward dislocation of the foot. Immediate reduction and plaster-of-Paris splint. Check-up x-ray on September 17 was satisfactory. Iron walking heel was applied on September 20, and patient was up and around, free from pain. Check-up x-ray on September 24 was satisfactory and patient was discharged to the care of her own doctor. She was seen in consultation seven weeks after the injury, cast was removed, and patient had normal

Fig. 5

Fig. 6

range of motion in the ankle joint and was able to walk without pain and with little or no limp.

CASE 5: Mr. N. B., age forty-four years. Hospital number A80719. Admitted October 9, 1929. Fracture of lower third of fibula and of the internal malleolus. Reduction and fixation with plaster-of-Paris. On October 10, cast was split and removed because of circulatory obstruction. Cast was reapplied on October 11 and iron walking heel incorporated. Check-up x-ray on October 13 was satisfactory; and patient was walking about ward without cane or crutches, no pain. On October 16 was discharged home. Forty-five days after injury, cast was removed; union was excellent, mobility of the ankle joint was normal, and patient was able to walk without cane or crutch. He resumed his occupation, that of laborer, 114 days after the injury.

The above described cases serve briefly to show what can be done to shorten hospitalization and disability in this type of injury. We have not yet, however, noted any marked reduction in the period of convalescence. Most patients complain of the injured member tiring easily and, in those cases where compensation is a factor, return to normal earning capacity is none too rapid. In other cases, however, especially in men of sedentary occupation, work has been resumed within a week after the injury; and in cases of housewives, all but the heavier household duties can be performed immediately on discharge from the hospital.

Further observations will be made to note whether or not union is hastened by this method.

MODIFIED BONE BLOCK (CAMPBELL) OF ANKLE FOR PARALYTIC DROP-FOOT

With Report of Twenty-seven Cases*

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The results of surgical treatment of drop-foot or paralytic equinus were most discouraging until the introduction of the posterior bone block of the ankle by Dr. Willis Campbell in 1923. The technique described

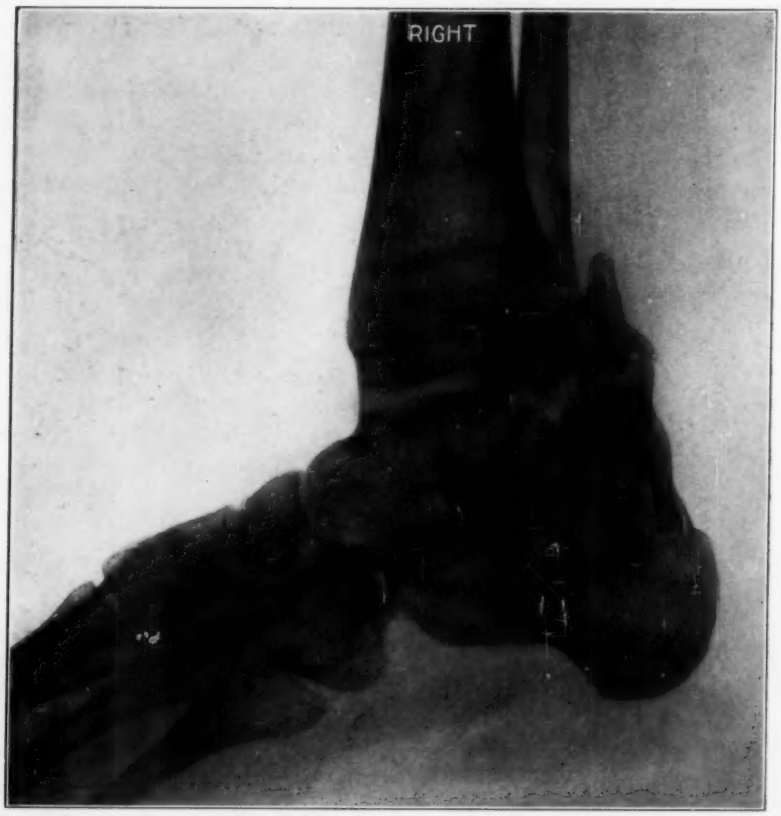

FIG. 1

X-ray showing posterior bone block according to Campbell's technique. There has been a fracture of bone. The result is satisfactory so far. The drop was checked, but there is no motion in the ankle joint. Case was operated upon again with technique of new type of bone block.

*Read before the Alumni of the Hospital for Ruptured and Crippled, New York City, November 17, 1930.

below includes a few definite changes from the original operation, and has given most satisfactory results in our Hospital. It has been free from complications or necessity of further operative intervention.

TYPE OF CASE

The most suitable age for performing the operation is above the age of fourteen, when the bones of the feet have almost reached their normal growth; but in well developed individuals it may be done slightly earlier. This report is confined to cases of definite drop-foot, which are associated with an active calf muscle group and slight power in the tibialis posticus. The greater number show the etiology to be anterior poliomyelitis, but there are also cases of spastic equinus due to hemiplegia of congenital origin, following fracture of the spine, or traumatic division of the common peroneal nerve. Very often a slight degree of varus was present, which was corrected also at the time of operation by the excision of the subastragaloid joint.

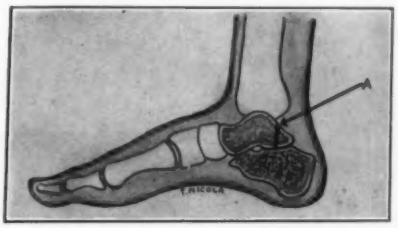

FIG. 2

First step of Campbell's operation is the removal of the posterior part of the astragalus as shown by line *A*.

FIG. 4

A large flap of bone (*C-C'*) has been removed from the os calcis. The smooth surface (*C'*) is intact.

FIG. 3

Second step in Campbell's operation is the obliteration of sub-astragaloid (posterior) joint. One-quarter inch of the upper margin of the os calcis has been removed (*B*).

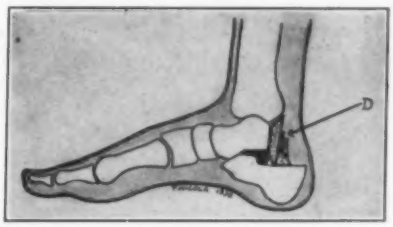

FIG. 5

The reflected part of the os calcis is placed under the posterior part of the tibia and approximates the posterior part of the astragalus. This differs from the technique of Campbell, who describes it thus: "Small particles are packed in a pyramidal manner extending one inch above and posterior to lower extremity of tibia". A new process is thus made which will impinge upon the inferior and posterior aspects of the tibia (See Fig. 1).

FIG. 6-A

X-ray showing the large area reflected from the os calcis impinging on the lower margin of the tibia (immediately following operation).

FIG. 6-B

X-ray two weeks after operation, when foot was temporarily placed in calcaneus to show the separation of the bone block from the posterior part of the tibia and how the new articulation is formed. This is not a routine procedure but was done for scientific reasons.

REASONS OF MODIFICATIONS

In a number of our earlier cases, in following the Campbell technique, a stiff ankle resulted and the only motion was in the mid-tarsal joints which caused an awkward gait or heel-walking. Fractures of the tip of the transplanted bone often occurred, accompanied by no symptoms, but often followed by increased motion in the joint. At times we were obliged to excise the redundant tip to secure motion in the ankle or to correct secondary varus deformity.

MECHANICS

Upon excision of the tip of the transplanted bone of the posterior surface of the tibia, the satisfactory result was evident and also the increased range of motion. It seemed that very little impingement of the bone was necessary to obtain the desired result. We have all noted how a small displaced osteochondral fragment in the knee joint or elbow joint may limit motion. By using the same principle in elongating the posterior surface of the astragalus, a normal joint surface can be secured and drop-foot satisfactorily prevented and with a considerable range of motion.

TECHNIQUE

The posterior ankle joint is exposed through a small incision lateral to the Achilles tendon, which is divided as in Campbell's original description. The projecting portion of the astragalus is excised as in Figure 2

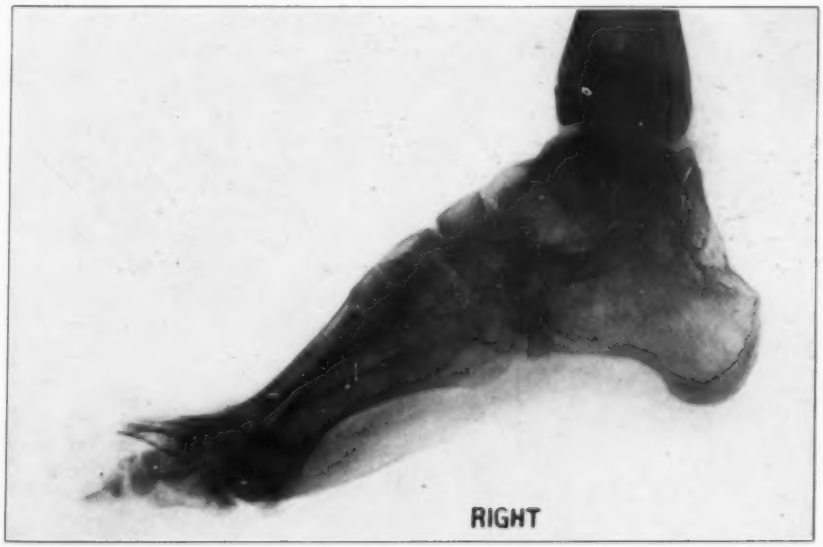

FIG. 7

X-ray at the end of two years. Right foot of Fig. 10, showing solidity of bone block and new articulation.

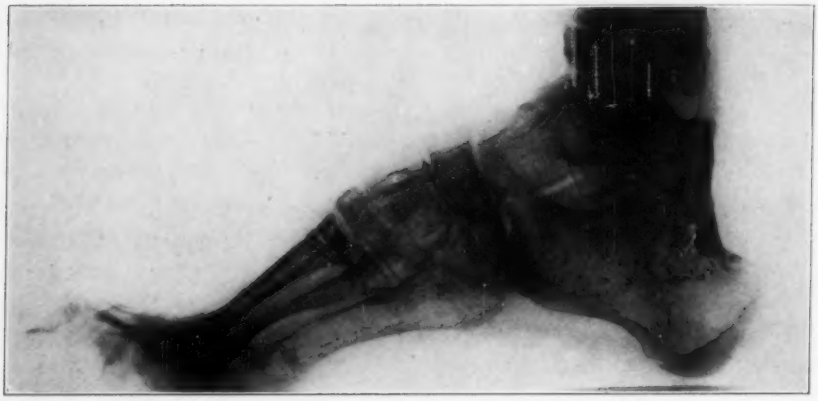

FIG. 8

X-ray of foot three years from date of operation. The smoothness of the articulation is demonstrated; there is no bone production.

and the subastragaloid joint is destroyed, taking a large wedge from the outer side of the articulation so the foot can be placed in valgus. A large section of the os calcis (whose superior surface has been denuded), measuring three by two by one centimeters (Fig. 4), is reflected and fitted under the posterior aspect of the tibia (Fig. 5) with the denuded superior surface resting against the astragalus. The transplanted bone must touch the tibia only when the foot is in five degrees of plantar flexion. A plaster is applied with the foot in valgus and at a right angle to the leg. Walking is begun in plaster at the end of one month; the plaster is removed entirely

FIG. 9

X-ray of foot five years from date of operation (left foot of Fig. 10). The appearance of the bone block is as if it had always been present.

after the third month. The outer border of the shoe (heel and sole) is raised one-eighth of an inch to retain the valgus position and walking is begun without support.

RESULTS

This procedure has been used on twenty-seven cases (one case bilateral) dating from 1925, with gratifying results. There has been no pain, and no recurrence of drop-foot. There is from ten to fifteen degrees of motion from the plantar check in dorsiflexion which, associated with the valgus position of the foot, makes walking easy and graceful.

Dr. Raymond Lewis, Roentgenologist of the Hospital for the Ruptured and Crippled, has made the following comparison of the x-rays of the Campbell bone block and this new procedure as related to the anatomical development of the transplanted bone and the arrangement of the articular surfaces of the ankle joint with the mechanism of support:

"The lateral views of the foot (Figs. 7, 8, 9) show that a smooth bony body with orderly bony trabeculae is fused to a new artificially made posterior surface of the astragalus and to a denuded upper surface of the calcaneus in the region of its posterior articular facet and to the bone just behind. The fusion is shown to be solid. The upper surface of this new bony body is very smooth and lies immediately beneath the posterior margin of the lower tibial articular surface, with a space of about one-quarter inch separating this new bone and the tibia. This upper surface seems to be continuous with the upper astragalar articular surface. With a small amount of plantar flexion this smooth surface would apparently come in contact with the posterior margin of the lower tibial articular surface and

FIG. 10-A

Photograph of feet in which a bilateral bone block has been done. The position of valgus of the ankles is clearly shown, which is so necessary to a satisfactory result and graceful walk in this type of procedure. (X-rays are shown in Figs. 7 and 9.)

FIG. 10-B

Lateral view of Fig. 10-A, showing feet after operation in slight equinus (bilateral x-rays, Figs. 7 and 9).

FIG. 10-C

Showing fullness about region of bone block, but contour is shapely (x-ray, Fig. 7).

prevent further plantar flexion. The films also show an obliteration of the posterior astragalo-calcaneal articulation.

"In comparing these films with a film illustrating a Campbell bone-block operation (Fig. 1), the present operation would seem to have several mechanical advantages. The present bone block is really a part of the astragalus and produces blocking by impingement of its upper extremity against the tibia. In the film illustrating the Campbell bone-block the bony body seems to consist of an exostosis projecting upward from the upper surface of the calcaneus into the soft tissues. It prevents plantar flexion by impingement of its anterior surface rather than its tip against the tibia in such a way as to produce a cross strain on this exostosis."

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TUMORS OF THE NERVE SHEATHS OF THE EXTREMITIES NEUROGENIC SARCOMAS*

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Since the time of Virchow, that group of tumors of the nerve sheath. known as neurogenic fibrosarcomas has appeared spasmodically in the literature. In recent years, the work and influence of Dr. James Ewing has been a source of renewed interest in these neoplasms on the part of our surgeons who have in general developed a more active interest in oncology. These tumors are not rare: Seventy-five cases were studied between 1912 and 1927 at the Memorial Hospital for Cancer and Allied Diseases; in 1924, Ott reported twelve cases from the Mayo Clinic; and European investigators have reported a number of smaller series. We have encountered about eight in the past two years.

In spite of these published studies it has been our experience that comparatively few cases have been recognized in the early stages. Because of the frequency of the appearance of these growths in the extremities, many of the patients come to orthopaedic institutions for relief. Four recent cases have been chosen for a study of the clinical course as well as diagnosis by gross and histological examination.

CASE 1. P. P., age twenty-six, came to the dispensary complaining of pain and tenderness at the site of a tumor over the right elbow. This growth was first observed nine years ago, but gave him no trouble until five years ago, when he awoke one morning to find the joint quite stiff. He could not recall having injured the joint in any way. In size the tumor is said to have been that of a peanut. At this time he went to the out-patient department of another hospital where the tumor, which was quite superficial, was removed. We have been able to find no record of the case at that institution, but the patient insists it was done in the clinic rooms.

However, soon after the operation the tumor began to grow again and this time attained much larger proportions. It was seldom spontaneously painful, but very tender when struck even lightly. Recently the patient had begun to experience an almost constant burning sensation radiating down the ulnar side of the forearm. After seeing a number of physicians, he came to the clinic to have it removed again.

General physical condition was good. On the medial side of the right elbow there was seen a swelling the size of a pigeon's egg. The slight scar of the previous incision was visible. The tumor was situated about an inch and a half below the medial epicondyle of the humerus. The skin was not adherent, nor was the tumor fixed to the underlying structures. There was no ulnar palsy nor muscular atrophy.

The tumor was removed under general anaesthesia. It presented no discernible connection with the ulnar nerve. It perforated the deep fascia and was lightly connected to the muscles.

Pathological study showed sections of tightly packed whorls of spindle cells with deeply stained nuclei. Through the field ran several strands of nerve tissue. Diagnosis: Neurogenic sarcoma.

*From the Service of Dr. S. Kleinberg.

This tumor is of undoubted malignancy. Although it is at present quiescent under deep radiation therapy, we feel that the prognosis is still poor, and local recurrence if not metastasis is to be expected.

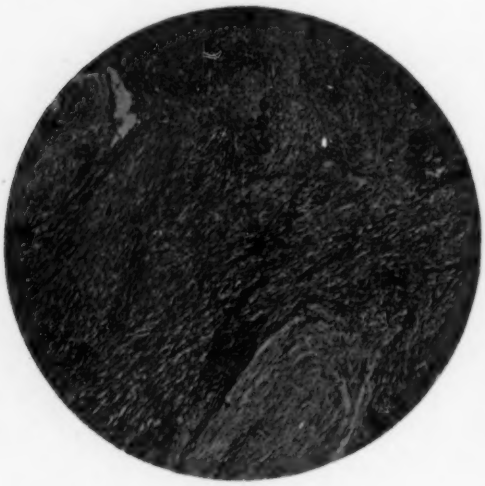

FIG. 1

FIG. 2

Figs. 1 and 2 represent low-power and high-power views of typical fibrosarcomas of the nerve sheaths. In the low-power view (Fig. 1) the characteristic whorl arrangement of the fibers can be seen to best advantage. These sections were taken from Case 1.

CASE 2. A. A., age twenty-six, came to the dispensary complaining of occasional pain along the outer side of the left leg. There was a small tumor over the lateral surface of the anterior muscle group at about the middle third which was quite tender. This growth had been present since childhood, but had caused no symptoms until the previous year when, following a moderate trauma, a sharp pain was felt running up and down the leg. Two months later the patient noticed an increase in size of the tumor from that of an almond to a large walnut. Physical examination showed this growth to be unattached to skin or bone, movable laterally but not vertically.

At operation it was found to be completely encapsulated, lying in the muscle belly of the peroneus longus. A small nerve could be seen entering its proximal pole. The mass was dissected out with its capsule intact.

Pathological sections showed a mass of myxomatous tissue, with very little cellular material left. The fibrous stroma was difficult to see in the diffuse degenerated areas.

This tumor was obviously of very low-grade malignancy. In this case the myxomatous degeneration was spontaneous and not, as is frequently the case, the result of previous radiation therapy. Its association with the nerve trunk was apparent. It probably arose from the sheath of a muscular branch of the deep peroneal nerve, within the muscle, since there was no sign of it externally. Origin from these smaller branches is by far the more common. (See also Case 1.)

CASE 3. L. C., female adult, represented still another type of these tumors. She presented on the plantar surface of the foot a small, superficial nodule, firm in consistency,

the size of a small green pea. It had been present since childhood, but until recently it had been entirely symptomless. At the time of operation it was painful, tender, and the cause of considerable difficulty in walking.

This small mass was easily excised and the patient made an uneventful recovery. Pathological examination showed a compact fibrous stroma with malignant-looking spindle cells, and an easily discernible whorl arrangement of the fibers. Diagnosis: Neurogenic sarcoma.

This tumor may easily recur in a few years. If it does, it will be larger and more dangerous. We consider this type of growth potentially very ominous, not because of an inherently high grade of malignancy, but because its innocuous appearance too often leads to a casual therapy most unwarranted. It was practically symptomless until adult life when the pressure of shoes and weight-bearing became a source of irritation.

CASE 4. M. G., age thirty-six, presented a large tumor of the lower third of the thigh, surrounding and apparently invading all the soft tissues of that area of the limb. The duration of the growth had been eight years. Radiation therapy already attempted had been without avail. Increase in size, the presence of pain, and the location of the neoplasm made amputation imperative in an attempt to save life. Hence a high femoral amputation was performed. The patient died next day, hardly recovering from the shock of the operation.

Pathological examination showed a large tumor arising from the connective tissues between the muscle planes of the lower portion of the thigh. There was no actual muscle-tissue invasion although considerable compression. Microscopically there was the usual proliferation of fibrous tissue, obviously neoplastic in parts, but very much obscured by tissue necrosis and myxomatous degeneration, the effect of previous radiation. Diagnosis: Myxomatous fibrosarcoma.

This case represents a rather common type of these tumors. The classification of nerve-trunk tumor may be doubted, inasmuch as so great an array of connective tissue is present in this locality from which a fibrosarcoma may be derived. However, the clinical features and the histological appearance have led Ewing and his followers to group these with the more definitely associated nerve-trunk tumors. The differential diagnosis between such a sarcoma and the invasive periosteal type, we believe, can be made only on clinical grounds. The latter type is more rapid-growing and metastasizes more frequently and earlier.

SUMMARY

Four cases of tumors classified as neurogenic sarcomas or tumors of nerve trunks are presented to illustrate a study of these neoplasms. They are derived from the connective tissue of the peripheral nervous system,—*i.e.*, the epineurium, perineurium, or endoneurium. The term "neurogenic" applied to these tumors is misleading, since it implies an ectodermic origin which, by definition, is incompatible with sarcoma. Hence we prefer the more unwieldy term "fibrosarcoma of the nerve sheath", as expressing more accurately the pathological concept of these neoplasms.

Clinically these tumors are characterized by slow growth, often existing from childhood. They may remain symptomless for many years, and suddenly become painful following trauma of even slight degree. Usually increase in size accompanies the onset of pain. Often the pain follows the distribution of the involved or associated nerve, and in this event the symptom is a great aid in diagnosis. It may be piercing or burning in character, but never in our experience does it resemble the dull gnawing ache of the periosteal or osteosarcoma. These tumors may be superficial or deep. The latter are more liable to be multiple, but must be distinguished from the neurofibromatosis of von Recklinghausen.

These tumors are all potentially, if not actually, malignant. The apparent harmlessness of a very small skin growth, obviously superficial, too often invites minor consideration which results in the unpleasant sequence of recurrence, metatasis, death. While in its primary state the tumor is of low-grade malignancy, trauma may activate it to a remarkably high degree. That trauma should not be thoughtlessly inflicted by the surgeon without full appreciation of the danger involved.

Many of these growths, especially the deeper ones, are encapsulated. Although relative benignity is thus preserved, it is no guaranty against recurrence. Metastasis in these tumors has been reported, even when surgery has not been used.

Early and complete excision followed by properly conducted deep radiation is the treatment advocated at present. Such tumors are quite radioresistant, so that treatment must be prolonged. At the operation the tumor will seldom be found associated with a large nerve trunk. The smaller muscular or cutaneous branches are more frequently involved. When no nerve structure is defined in the gross specimen, one may still discover strands of fibers in microscopic study.

The small, superficial, harmless-appearing, cutaneous nodule must not be exempt from consideration. It may be of considerable malignancy. Multiplicity must always be borne in mind, and as much search made for nearby growths as is feasible.

CONCLUSION

More careful consideration must be given to soft-tissue tumors of the extremities. Surgeons must realize that even the innocuous-looking nodule, or long-standing tumor in the arm or leg, may be composed of elements in which the inherent danger of malignancy is vital. Among these are the unusual but not rare fibrosarcomas of the nerve sheaths. These neoplasms require radical therapy. Because of their frequent location in the extremities, these cases tend to gravitate to orthopaedic institutions, and it is therefore incumbent upon men working in that field to recognize and be prepared to treat them.

May I here thank Dr. Samuel Kleinberg and Dr. Leo Mayer for permission to include the cases above described, and Dr. H. L. Jaffe for valuable assistance in the laboratory.

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COMPLETE ABSENCE OF BOTH LEGS—CONGENITAL*

BY GEORGE V. FOSTER, M.D., PITTSBURGH, PA.

In a review of the literature, I have been unable to find any record of complete congenital absence of both legs. Harald Nilsonne in *Archiv für Orthopädische und Unfall-Chirurgie* (*Über den kongenitalen Femurdefekt.* XXVI, 138, 1928) brings the literature up to date in a review of eighty-two cases of congenital absence of the femur. He states that it is extremely doubtful as to whether there is ever a complete or total absence of either femur.

This girl is now five years of age, active mentally, and gets about surprisingly well, using her arms as crutches to swing herself over the floor. Her arms are extraordinarily developed for a child of this age. She is the youngest of a family of five, the oldest of whom is eighteen. None of the

FIG. 1

*From the wards of the Children's Hospital of Pittsburgh, service of Dr. Wm. O'Neill Sherman.

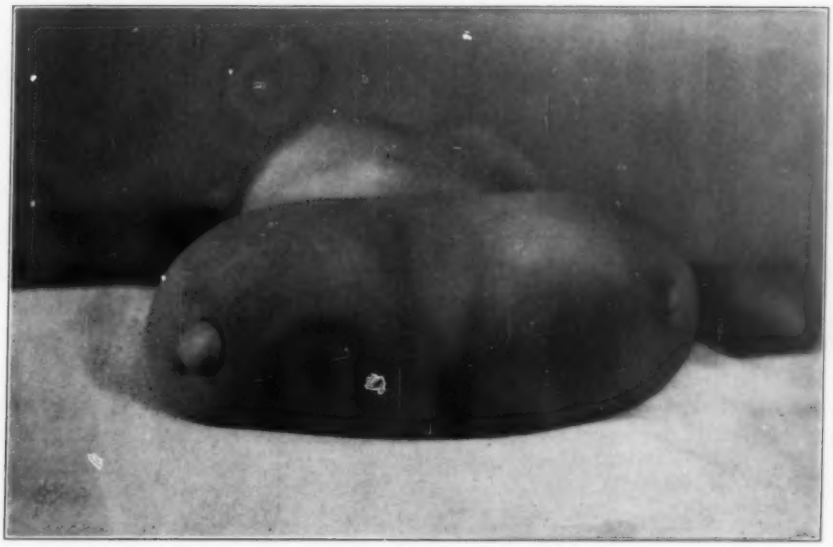

FIG. 2

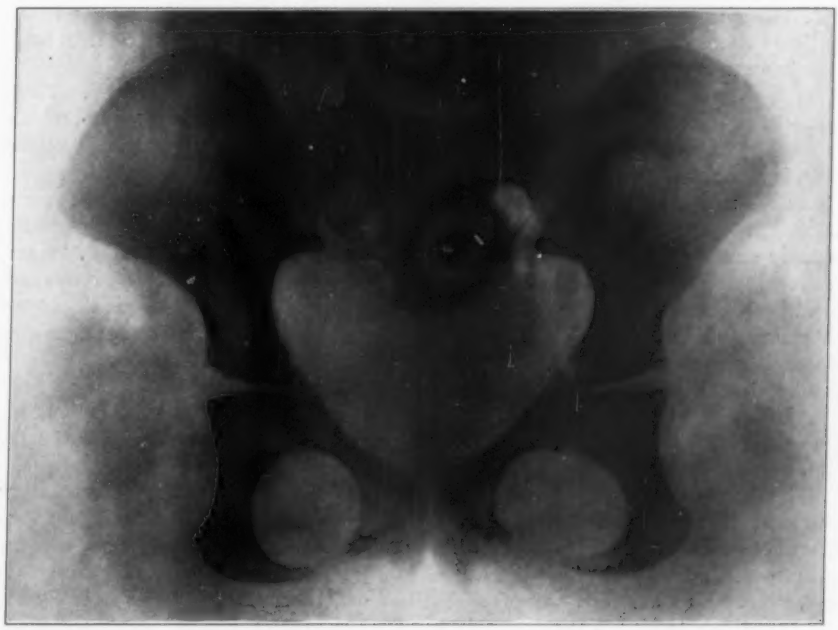

FIG. 3

X-ray shows congenital absence of both femora. There is some deformity of the lower portion of the pelvis about the obturator foramen. There is no evidence of an acetabulum on either side.

other children shows any congenital defects, nor does this child show any abnormalities other than those shown in the radiograms.

Soon this child is to be fitted with one artificial leg and an attempt made to have her walk with the aid of crutches.

TUBERCULOUS TENOSYNOVITIS OF THE PALMAR SYNOVIAL BURSA: "COMPOUND PALMAR GANGLION"

A Case Report

BY ALEXANDER GILLIES, M.B., F.R.C.S. (ED.), WELLINGTON
NEW ZEALAND

From Department of Orthopaedic Surgery, Lockwood Clinic, Toronto, Canada

This case is unusual in so far as the tenosynovitis was bilateral and was associated with tuberculosis of the genitalia. Bilateral tuberculous tenosynovitis is a rare lesion and merits reporting.

Clinical History. The patient was a white male, aged fifty-nine, an iron-molder by occupation. No family history of tuberculosis was obtained. He came to the Lockwood Clinic in January 1929, complaining of pain and swelling of the hands and wrists. This first appeared in the left hand in May 1928. The left wrist became swollen at that time and remained so. During the week before admission to hospital the right hand and wrist became affected in similar fashion.

The pain was most marked in the morning and at night, disturbing his sleep. There was loss of strength in the left hand, numbness of the volar aspect of the thumb, middle and ring fingers, and some soreness and loss of power in the fingers. He had developed the habit of striking his left hand on the thigh in an attempt to revive it. At the same time as the trouble commenced in the left wrist, the left testicle became swollen and painful, but this condition was somewhat relieved by ice-packs and the swelling became gradually smaller. The condition had been variously diagnosed as "sprain", "ganglion", and "arthritis" and he had been under treatment for arthritis for some months.

Examination. When he came to the Clinic there was a moderate spindle-shaped doughy swelling on the anterior aspect of the left wrist just above the annular ligament, with slight swelling of the palm below. There was some fluctuation and the flexor sheath appeared to be thickened. Flexion and dorsiflexion were limited. On pressure in the left palm with one finger and on the swelling proximal to the annular ligament with another finger, small bodies could be felt passing under the carpel tunnel from the palm.

The right wrist showed slight swelling with limitation of movement. There was no numbness. No loose bodies could be palpated in the common flexor sheaths, but they could be felt and moved about in the sheath of the flexors of the index finger opposite the metacarpophalangeal joint. He had had an injury of this joint some years before, having been hit with a hammer. The fact that both wrists were affected was probably one reason for the confusion in the diagnosis, but on "see-saw" palpation the characteristic crepitation of bodies passing through the carpal tunnel was unmistakable.

The left testicle was enlarged and hard, but not tender. Beading of the vas could be felt on palpation. The prostate was hard, firm, and non-resilient, particularly on the left side. The left vesicle and the left epididymis in both upper and lower poles, were enlarged, hard, and indurated.

Diagnosis. The diagnosis was tuberculous tenosynovitis of the flexor tendon sheaths and tuberculosis of the genitalia. The chest was negative both on clinical examination and radiographically. It was impossible to say which was the primary focus of tuberculosis.

Operation. A longitudinal incision four centimeters in length was made medial to the palmaris longus. The median nerve was retracted laterally; the common flexor tendon sheath bulged into the wound and was opened, showing a thickness of two millimeters. Fibrinous material and straw-colored fluid were evacuated, greatly reducing the swelling. Pressure over the palm expressed many melon-seed bodies from the wound. A portion of the greatly thickened tendon sheath was excised for examination, and after injection of ten per cent. iodoform emulsion in glycerin, the sheath was closed with fine catgut and the skin with silk-worm and dermal sutures. A cock-up splint was applied for immobilization of the wrist and hand.

Microscopic examination of the tissue showed areas of rather dense connective tissue in which were seen characteristic tubercles which often showed central giant cells surrounded by areas of caseous material. Around these areas of necrosis there was a dense lymphocytic and endothelial cell infiltration. The connective tissue showed slight diffuse lymphocytic infiltration. The pathologist's diagnosis was "tuberculosis".

Subsequent History. The patient refused to believe that his condition was tuberculous and would not seek lighter or more suitable work. On the contrary, he returned to his old occupation of iron-molding eight weeks after the operation. Five months later he reported at the Clinic. The numbness had disappeared from the fingers of the left hand and the swelling had disappeared from the wrist. The grip with the left hand was much stronger than that of the right. Dorsiflexion and flexion were almost complete. The wound remained soundly healed and no melon-seed bodies could be detected on pressure over the palm and tendon sheaths.

The right wrist, however, remained painful and swollen and numbness of the index and middle fingers had developed. Loose bodies could still be felt in the flexor tendon sheath of the index finger at the level of the metacarpophalangeal joint, but not elsewhere.

Trauma appears to be an etiological factor, and more commonly the right hand is affected. This patient was right-handed but used both hands equally in his work. The dense palmar fascia affords much protection, but once the palmar synovial bursa has become the site of a tuberculous process, the range of movement of the flexor tendons, which averages one centimeter at the annular ligament, militates against spontaneous healing. The swelling is due, in part, to the presence of the granulation tissue which distends the tendon sheath. Were it not for the band-like constriction of the annular ligament, the swelling would not be described as "above and below the annular ligament", but would simply be one large swelling. Involvement of the median nerve is responsible for the sensory changes.

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A CASE OF CONTINUED GROWTH AFTER LOSS OF BONY EPIPHYSIS

BY C. B. BENNETT, M.D., BERKELEY, CALIFORNIA

The following case seems worthy of note as it presents continued growth of bone in a finger after complete loss of its bony epiphysis.

On September 29, 1927, M. McF., a girl of two years, was brought to my office with a severe osteomyelitis of the proximal phalanx of her left middle finger. Under ether anaesthesia the finger was opened, and two weeks later the opening was enlarged. A splint and vaselin compress were applied.

On October 21, 1927, the entire bony epiphysis became extruded through the wound. This fact was verified by x-ray examination. The course of the infection was stormy at first, but by the end of November the acute symptoms disappeared. Extrusion of bits of dead bone occasionally occurred until the following August, when the skin wound healed.

The phalanx, however, grew three-sixteenths of an inch from October 1927 to July 1930. In the same period of time the shaft of the corresponding phalanx of the other hand grew only one-thirty-second of an inch longer than did the injured one. The middle phalanx and the metacarpal of the injured finger,—that is, the bones at each end of the affected bone,—each grew one-sixteenth of an inch longer than the corresponding bones of the uninjured hand. The result was that the whole injured finger, despite its loss of epiphysis, measured almost as long as its mate on the other hand. The rest of the bones of the left hand were apparently not affected by the infection. (Measurements from x-rays at twenty-five inches.)

The last examination showed the proximal end of the affected phalanx to be very irregular, the growth having been uneven and greater on the dorsal part. X-rays taken on and before November 21, 1929, showed no sign of regeneration of the bony epiphysis.

FIG. 1
Sept. 29, 1927. X-ray negative.

FIG. 2
Oct. 21, 1927. Epiphysis gone.

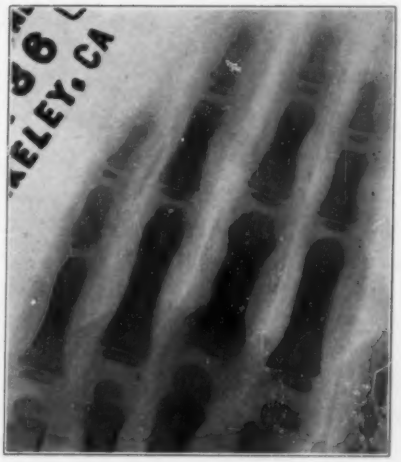

FIG. 3
July 16, 1930. Anteroposterior view.

FIG. 4
July 16, 1930. Lateral view.

X-rays of July 16, 1930, showed the development of a very small round piece of bone on the radial side of the joint which might possibly be a tiny new epiphysis. The movements of the joint are now full, free, and painless.

That the growth of bone may be stimulated by an inflammatory reaction near its epiphysis is well known, so that the fortunate compensatory growth of the other bones of the finger is not surprising. Although Haas[1] has shown in rabbits that a careful resection of the knee joint in which the entire articular cartilage and a thin layer of adjoining bone are removed, will cause no destruction in length of growth, the epiphysial cartilage has been considered a very vulnerable tissue[2], and injury to it usually results in non-growth, as well shown by Haas[1], and also by Gatewood and Mullen[3]. It seems remarkable, therefore, that the epiphysial cartilage in the above case remained viable and active after being bathed in so much pus, and after the bony epiphysis became detached and extruded.

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SUPINATION SIGN

BY R. M. YERGASON, M.D., F.A.C.S., HARTFORD, CONNECTICUT

If the elbow is flexed to ninety degrees, the forearm being pronated; and the examining surgeon holds the patient's wrist so as to resist supination, and then directs that active supination be made against his resistance; pain, very definitely localized in the bicipital groove, indicates a condition of wear and tear of the long head of the biceps, or synovitis of its tendon sheath.

CASE REPORT

A woman of forty-five years had had pain in the right shoulder and arm for one year, and had been treated by rest, liniments, and electrical treatments throughout that time, without avail.

She described the sensation as "not a true ache, or pain, but a peculiar 'hurt'", on moving the arm in certain activities. She considered the condition to be neuritis, which had been the former diagnosis made by several physicians.

Careful palpation along the courses of various nerves revealed no tender point. There was slight tenderness, rather indefinitely localized, at the greater tuberosity of the humerus; there was free motion of the shoulder throughout its normal range; the sign described above was positive.

The patient, whose attention was focused upon the wrist, was surprised, exclaiming with the pain in the shoulder, and with her finger, locating it exactly in the bicipital groove. Active supination, without resistance, brought out the pain slightly, when forced. No other motion seemed to produce it with any definiteness whatever.

On inquiry, it was learned that the patient did a large washing daily throughout the week, wringing all the clothes by hand, hanging them out, ironing, and mending the same. It seemed that the wringing and the mending, in particular, had called forth enough activity to produce wear and tear of the biceps tendon in its groove.

Buying a washing machine with a wringer, and going light on mending, without other treatment of any nature, produced complete recovery in less than a month.

Dr. A. W. Meyer[1] has shown that, in use destruction, the biceps tendon wears away the lesser tuberosity sometimes to such an extent that the tendon slips over it out of the groove. In fractures of the lesser tuberosity of the humerus, even without displacement, the supination sign will be positive.

The sign will be found negative in cases of partial or complete rupture of the supraspinatus tendon, which are very common, and, for the diagnosis of which Dr. F. J. Cotton[2] has called our attention to a valuable sign.

It would seem that the above case is sufficiently definite to warrant the reporting of this sign, which has been found very useful in cases of shoulder injury.

1. Meyer, A. W.: Unrecognized Occupational Destruction of the Tendon of the Long Head of the Biceps Brachii. Arch. Surg., II, 130, 1921.
2. Unpublished as far as the author can learn.

NEUROTROPHIC DISTURBANCES OF THE HAND ASSOCIATED WITH A BITE OF A CAT OR COLLES' FRACTURE

BY HENRY TURNER, M.D., LENINGRAD, U. S. S. R.

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It has been the author's opportunity to observe in several instances a clinical phenomenon following a severe bite of an animal, evidently with injury to branches of the interosseous nerve, which would seem to have a distinct bearing on the etiology of the marked atrophy and contraction sometimes following a Colles' fracture. Experience has frequently attracted attention to an aberration of the healing of a Colles' fracture from the usual course, which necessitated prolonged treatment and finally led to serious functional disability. The picture of this complication is very characteristic; it has been vividly described in connection with lesions of the terminal part of the radial nerve. Its principal component is a hard swelling of the dorsum of the hand, spreading towards both the fingers and the forearm. A stiffness of the fingers and of the wrist further ensues in an extended position with painful resistance to any attempt at passive flexion (Fig. 1).

FIG. 1

Female, age 45, pianist. Appearance of left hand nine weeks after Colles' fracture with involvement of the dorsal interosseous nerve. Hand swollen, skin glossy, fingers stiff.

This deviation from the general mild course of a Colles' fracture has been noted by eminent writers. Malgaigne alludes to it in his work on fractures; and Goffres, a later French writer, speaks of this condition as a rare occurrence; and modern textbooks often but briefly describe it. In this well recognized condition there is first seen a distinct swelling of the dorsum of the hand, which generally appears a week or two after the accident and has little resemblance to simple oedema. The stiffness of the fingers as mentioned above is the second outstanding component of the pathological syndrome. Fixed in a state of extension, they remain refractory to any attempt at active or passive flexion which provokes pain. A glance at the dorsum of the forearm reveals distinct wasting of the extensor muscles which on palpation show a certain degree of rigidity. Further instructive findings, coherent with the symptoms already described, show a grayish pallor and dryness of the skin, a typical glossy appearance,

interrupted by areas of desquamation and sweating, which suggests a vasomotor phenomenon. Positive proof of profound neurotrophic disturbances is obtained by examining the x-ray plate which reveals decalcification of the lower end of the radius and ulna, the phalanges, carpal and metacarpal bones, especially distinct in the proximal ends of the latter (Fig. 4).

The literature gave added information on the primary factor in the pathogenesis of this clinical syndrome. A photograph of a swollen hand produced by Fürstner (1903) as a typical example of vasomotor disturbance, awoke my attention. Although the author did not accentuate the significance of trauma in the etiology of his cases, which he vaguely described, yet on closer examination of the clinical histories, the fact that trauma had preceded the evolution of vasomotor disturbance could not be rejected. Sufficient further references were to be found in literature as to the swelling of the hand named "*hartes Oedem des Handrückens*" by the Germans and primarily described by Vulliet. Secretan observed a case of oedema artificially produced by percussion of the wrist. The experience of the last war brought abundant material touching the same subject (Lange, Schede, Hoffmann). Stromeyer described a case of swelling produced by a prick of a needle.

Regarding the clinical syndrome composing the complication of Colles' fracture from a standpoint of nerve irritation, one may not hesitate in pointing to the special nerve branch which is prone to be involved in the typical injury of the radius. Tinel stresses the specific trophic rôle of the terminal branches of the posterior interosseous nerve. The final ramifications of this small trunk are briefly depicted by anatomists. According to Rüdinger it terminates in the region of the wrist and, after dichotomous splitting, gives off three or four branches towards the base of the metacarpal bones; small filaments also supply the bones, ligaments, and capsule of the carpus. Saposchcoff was able to trace some of these threads running along the dorsum of the three middle fingers but not reaching the terminal phalanges. Linell's minute researches also refer to the final distribution of the interosseous nerve in relation to the carpal joints. Considering these anatomical facts, one can easily understand the correlation between the distribution of the terminal filaments of the nerve and the area of decalcification seen on the roentgen plate.

As to the well marked finding on the roentgenogram, we need not emphasize the neurotrophic origin of the decalcification observed in the bones of the hand. Samuel was the first to record observations of this kind. Kienböck and Sudeck described it as a concomitant to inflammatory processes and injuries. To the latter it owes its name—acute bone atrophy.

A favorable accidental concurrence came to corroborate our conception of the nature of the above syndrome and the causative agent accountable for its development. During a short period in the spring of 1924 we had the opportunity of observing three consecutive cases of a cat bite on

the wrist with sequelae so closely resembling the clinical condition already described, occasionally following a Colles' fracture, that it seems to be of value in the study of the pathology of this syndrome.

Mrs. N. B. came to our clinic complaining of swelling of the left hand and wrist and acute pain in the same region. A month previous to admission she had been bitten by her cat. Since then she had undergone treatment by compresses, passive hyperaemia, and warm baths, without success. Some small scars were visible on the dorsum of the wrist. One of the marks corresponded to the situation of the dorsal interosseous nerve. The appearance of the injured limb reiterated every detail of the picture of trophic and vasomotor disturbances with which we had become familiar. Palpation along the irritated nerve produced sharp pain. The symptoms gradually subsided under treatment by warm baths and absolute rest, but even after two months the swelling remained visible and the patient was not able to clench her fist.

FIG. 2

Woman, age 58. Colles' fracture with interosseous involvement five months previous. Left hand. Note the wrinkling of the skin a few days after resection of the nerve. Operative scar distinctly visible. (Courtesy of Dr. Novotelnoff.)

The second case was that of a woman medical student, aged twenty-five, who had been bitten in the same location by a cat four months before admission to our clinic. The typical clinical symptoms were more effectually manifested. The patient had been under special treatment but the diagnosis remained obscure. A series of x-ray pictures made in three consecutive periods by the roentgenological institution were kindly lent to me for examination. The progressive rarefaction of the bones was clearly manifested by the plates. The acute symptoms of the illness gradually quieted down after another four months of conservative treatment, but the rigidity of the joints and wasting of the muscles could be traced much later.

The third patient was a boy, who came to the clinic four days after being bitten by a cat, also in the region of the wrist. Signs of nerve irritation were absent in this case and the boy made a quick recovery.

These three cases observed during a short period presented themselves as well premeditated clinical experiments destined for studying the effect of an isolated lesion of the interosseous nerve. In the first two was reproduced the detailed picture of reflex phenomena proceeding from nerve irritation.

In a case of an elderly woman with long-standing pain in the hand and stiffness of the fingers after a Colles' fracture, a resection of the interosseous nerve immediately lessened the morbid symptoms. The first statement made by the patient on awakening from narcosis was that her fingers "had become loose".

Further information in regard to the nerve resection was given by Dr. Skobelzin at the meeting of the Leningrad Orthopaedic Society on March 20, 1929, who reported the resection of one centimeter of the nerve in a case also following a cat bite, and with successful result.

The following case has exceptional interest:

A man, aged thirty-four, received a severe cat bite on the left wrist on Oct. 30, 1929. A painful swelling of the wrist immediately ensued, increasing towards the evening. The man passed a restless night. Beginning November 2, he received four antirabic inoculations, although the cat remained perfectly sound. The swelling and pain persisted during the following month. The latter was of a causalgic type. A false step, a fit of coughing or sneezing, and mental emotion brought on exacerbations of the suffering, the type which we find so vividly described by Platt and Bristow. The patient was admitted to the surgical wards of the clinic November 9. On examination two distinct scars were visible on the dorsum of the wrist, corresponding to the interspace between the extensors of the thumb and the index on a level with the radial epiphysis. Traces of the cat's lower teeth were feebly marked on the lateropalmar circumference of the wrist, slightly distal to the styloid process of the radius. The outward appearance of the injured limb strictly paralleled that which we have depicted. The radiographic appearance of the wrist, hand, and fingers indicated gross pathological changes in the bones.

During the subsequent month, the condition of the patient remained unchanged. The temperature was normal. As treatment by immobilization and physiotherapy was of no avail, it was decided to try a conservative measure directed against the primary factor, and one-fourth gram of five per cent. tincture of iodin was injected deeply under the skin in the area of the irritable point of the nerve. The injection was accompanied by a violent burning pain, but the pre-existing persistent pain subsided in a few hours. Later the injection was repeated and the patient made an uninterrupted recovery (Figs. 6 and 7).

The simplicity and instructiveness of the above history need not be emphasized. One cannot but stress the close relationship between the above described clinical picture and the precise location of the seemingly insignificant injury. The absolute identity between the disturbances produced by the bite of a cat and those following some cases of Colles' fracture excludes the idea of septic foundation.

The frequent vulnerability of the dorsal interosseous nerve, confirmed by our observations, led us to a closer study of its anatomical situation and its relation to the underlying epiphysis of the radius, the dorsal outline of which shows so many variations. Tracing the delicate nerve trunk in the lower third of the forearm, one can see it keeping to the radial side of the extensor pollicis longus and finally dipping under the muscle before gaining the interosseous membrane. Linell observed anomalies in which the nerve continued its downward course superficial to this muscle. Making its way towards the wrist in immediate contact with the posterior surface of the

FIG. 3

Area of decalcification a month after a bite of a cat. Location of two wounds on the dorsum of the wrist marked by round fragments of tin.

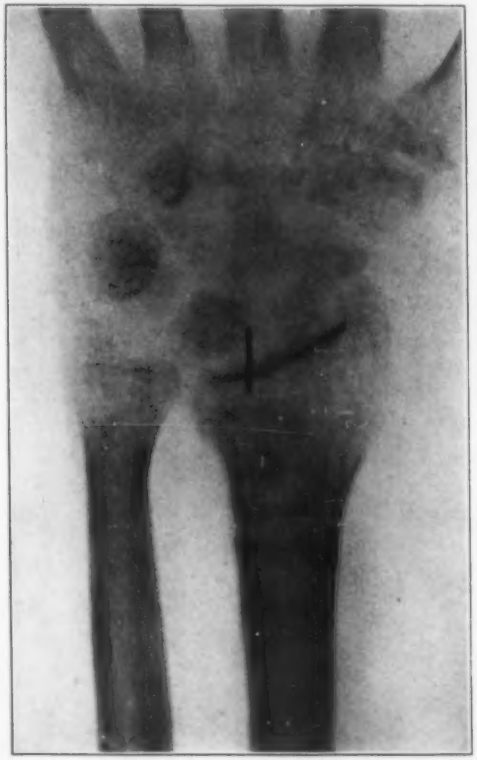

FIG. 4

The same case as shown in Fig. 3. Decalcification is more distinct. A fragment of a needle, placed on the skin, marks the interspace between the two wounds.

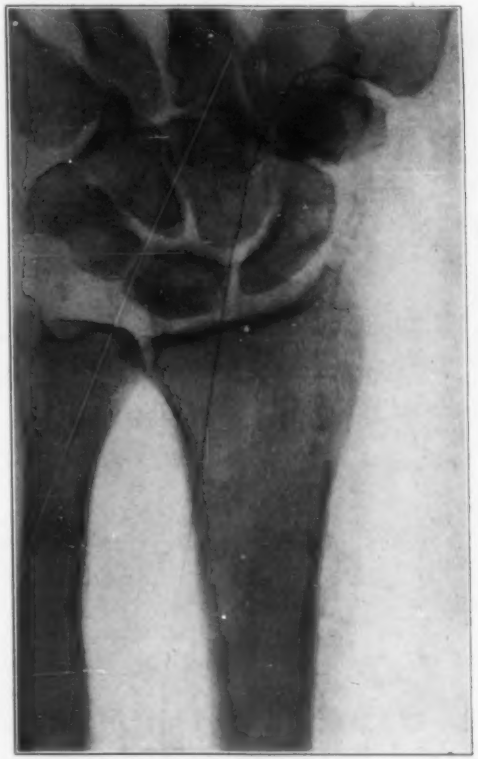

FIG. 5

Projection of the course of the interosseous dorsal nerve obtained by threading a fine wire into the sheath of the nerve. Note the parallelism of the line to the line in Fig. 4. (Credit is due to Dr. Novojiloff for his experimental work in this field.)

FIG. 6

Degree of flexion of the fingers a month after blocking the interosseous nerve with weak tincture of iodin (described in our last case of stiffness of the fingers and swelling of the hand resulting from a cat bite inflicted a month previous to operation). Picture reproduced from a photograph.

FIG. 7

Exuberant growth of hair on the left forearm as vestige of vasomotor disturbance.

radial epiphysis, the nerve keeps to the ulnar side of the elevated groove, which serves as a pulley for the extensor pollicis longus tendon, not coming under cover of the extensor indicis tendon, but ascending the slope formed by the ulnar side of the outstanding groove. It then dips into the wrist, and breaks up into its terminal branches, thus becoming firmly fixed. It must be remembered that the entire tortuous course of the musculospiral nerve, in close contiguity to the skeleton, makes it very liable to injuries of different kinds. A lesion of the radial nerve in fractures of the shaft of the humerus is a common occurrence. Linell notes the possibility of the same complication in fractures of the upper end of the radius where the nerve is firmly bound to the neck and upper part of this bone. The anatomical disposition of the interosseous nerve is especially disadvantageous in this respect. Taking into consideration its fixed proximity to the bone surface and its superficial situation under a thin cover of integuments, one might expect more frequent involvement of the nerve in the various injuries of the wrist headed by Colles' fracture. It is admissible further to expect reaction of the terminal filaments of the same nerve to injuries of the bones of the hand. Our observations tend to support such an assertion. Scanty allusion to this subject is found in literature. It may be that the specific functional rôle of the nerve contributes to the difficulty of recognizing a lesion of its small branches. The author has observed a case of swelling of the hand, following a bite of a cat, which had been mis-

taken for cellulitis and incised. "It must be repeatedly stated", writes Tinel, "that the radialis nerve is very slightly sensitive. Its irritation is not manifested by the gross syndrome of neuritis of a cubital or median nerve. Sensibility is marked to a certain degree by pain on pressure in the region where the nerve crosses the head of the radius. But if the sensory disturbance is slightly manifested, the trophic effect is very important." The writer further speaks of trophic disorders following injuries of the terminal part of the radialis nerve even as far down as the wrist. However, the reader is left in uncertainty as to the exact level of the damage.

After having studied the causative agent of the morbid entity, our attention fell upon a valuable publication of Dr. Bruce Gill touching an analogous subject. Dr. Gill describes a characteristic disability of the hand observed chiefly after Colles' fracture and sometimes resulting "from any fracture or dislocation of the upper extremity". The picture of the disability is essentially similar, one might say identical, to that which we have described as typical. Fingers fixed in an extended position, smooth glossy skin, and prolonged swelling of the hand are the chief characteristics of the clinical entity. Dr. Gill comes to the conclusion that the swelling may be regarded as the cause of the loss of function. As to pain or other signs of nerve involvement having played a rôle in the clinical manifestations of the pathological process, the question remains unmentioned by the author. An x-ray picture of the hand is also lacking. The pathological process underlying the very definite clinical appearance of the disability is summarized under the name of "fibrous ankylosis of the hand". In his conclusive remarks following the discussion of his paper, Dr. Gill abstains from entering into the theory of causation of fibrous ankylosis of the hand, not being altogether sure of the details of its pathology. It remains to him an open question whether or not infiltration about the nerves and essential muscles plays a part in the final results.

In reporting these cases, we do not venture to add any new material to the pathology of profound disturbances resulting from an injury to a peripheral nerve of the upper limb. The fact of the close association of oedema and glossiness of the skin with neuritis, although universally known, was mentioned anew by Gibson in 1912. And yet my experience allows me to assert that in general every-day surgery the involvement of nerves in injuries to the distal part of the upper and lower extremities frequently fails to be recognized.

The significance which we ascribe to the interosseous dorsal nerve in the production of the above syndrome in Colles' fracture must, however, be limited. It is a well known fact that this fracture is very frequently complicated by a concomitant avulsion fracture of the styloid process of the ulna. Involvement of the final branches of the ulnar nerve thereby produced in some cases obscures the solitary effect of injury to the nerve. Slight sensory disturbances in the fingers complained of by some of our patients might also point to the participation of the median nerve in the complication of the fracture. The exclusion of such possibilities in cases

of animal bite furnishes opportunity for studying, as in a well premeditated experiment, the effect of an isolated lesion of a definite nerve in other conditions, such as these atrophic syndromes following a Colles' fracture.

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MEASURING LENGTH OF LOWER EXTREMITIES

A New Method

BY E. P. QUAIN, M.D., BISMARCK, NORTH DAKOTA

The accompanying drawing shows a method of measuring the comparative lengths of the lower extremities which, so far as known, has not been mentioned in textbooks or medical literature. The illustration is self-explanatory.

When abnormalities or apparatus for treatment obstruct the normal landmarks, it is sometimes very difficult to make exact comparisons by the usual methods of measuring from anterior superior spine, or trochanter, to malleolus. By this method only *one* fixed point is required for measurement and this is the point usually most accessible and definite. Inequalities of length are more readily noted by this method because they appear twice as great as the actual difference. This method of measuring from the anterior superior spine, around the sole of the foot and back again to the anterior superior spine, is especially useful in the following conditions when wounds, deformities, dressings, splints, or plaster casts make it difficult to determine exact landmarks about ankle, hip, or knee.

Fig. 1

It goes without saying that during the measurements and comparisons, both legs must lie, or be held, in exactly the same positions, or angles, with respect to the long axis of the body. In making the measurements, care must be exercised that the tapeline passes at the same distance from the back of the heel on both feet and also that the line passes in the same relation to the kneecap and malleoli on both sides. When a tapeline of sufficient length is not available, a narrow roller bandage will serve equally well. In the presence of dressings over a wound, for instance, about the ankle, which would change the line occupied by the tapeline, it has been found serviceable to apply a dressing of similar volume on the normal limb in order that the tapeline, or lines, will occupy similar positions on both sides.

A BONE LENGTHENING APPARATUS

BY BEVERIDGE H. MOORE, M.D., CHICAGO, ILLINOIS

The advantage of being able to lengthen a bone shortened by poliomyelitis or fracture has long been recognized. Jones, Putti, and others successfully performed operations for this purpose but the percentage of failures was high. Abbott of St. Louis deserves the credit for placing the operation on a sound surgical basis by recognizing the fact that callus, in the formative stage, can be molded by traction.

In attempting to utilize the same principle in the same way we have developed an apparatus which may be of interest. It is the evolution of a number of attempts to simplify previous apparatus.

It consists of two round bars held rigidly parallel. At one end are fastened two lugs through which two pins fixing the upper fragment are passed. Two tubes sliding on the bars carry the lugs which support two pins in the lower fragment. These two tubes are fastened together rigidly by a bar. Traction is made by a single nut and screw with a spring to give elasticity to the pull.

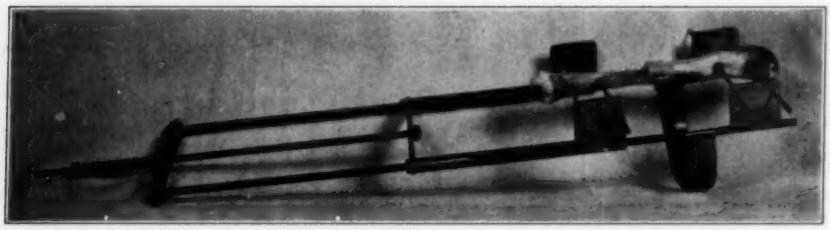

FIG. 1

Lateral view. In these pictures the bone was a sheep bone; hence the disproportion between the length of the apparatus and the bone.

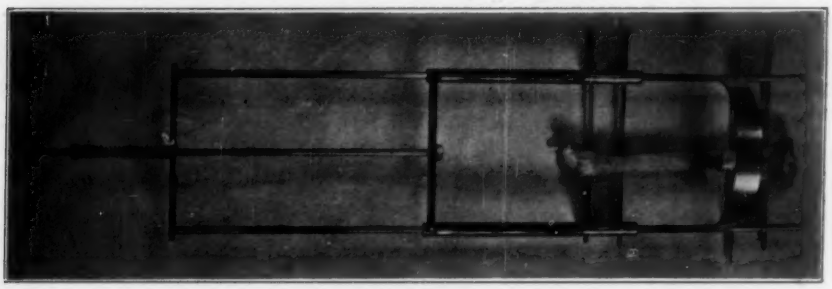

FIG. 2

Anteroposterior view.

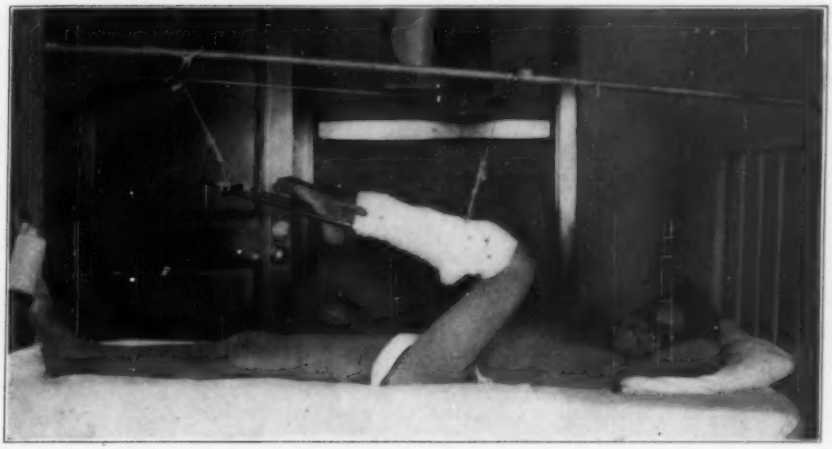

FIG. 3
Method of employment. The amount of motion permitted is shown.

When using this apparatus it is sterilized with the other instruments. The fibula is divided first. The usual long Z incision is made in the tibia but the bone is not completely separated. The pins are then drilled through the bone above and below with the apparatus in place. The separation of the tibia is then completed. The apparatus holds the bone in position while the wound is being closed. The four pins and the rigid bars hold the bone fragments in their relative position and the lengthening is accomplished by the screw and spring. After the operation the apparatus is suspended from an overhead frame by pulleys and light weights. This arrangement allows the patient considerable motion at the knee.

The advantages of the apparatus are its simplicity, and sufficient rigidity to hold the fragments firmly, the only motion possible being the sliding desired.

The apparatus was made by Mr. Dreher, brace-maker at the Chicago Unit of the Shriners Hospital.

DEROTATING CHAIR FOR THE TREATMENT OF SCOLIOSIS

BY CLARENCE A. RYAN, M.D., C.M., VANCOUVER, BRITISH COLUMBIA

In *The Journal of Bone and Joint Surgery* mention was recently made of a rotation apparatus for mobilization treatment of scoliosis.[1] This apparatus, in the writer's hands, does not fully cover the needs. For this reason the following description is being published.

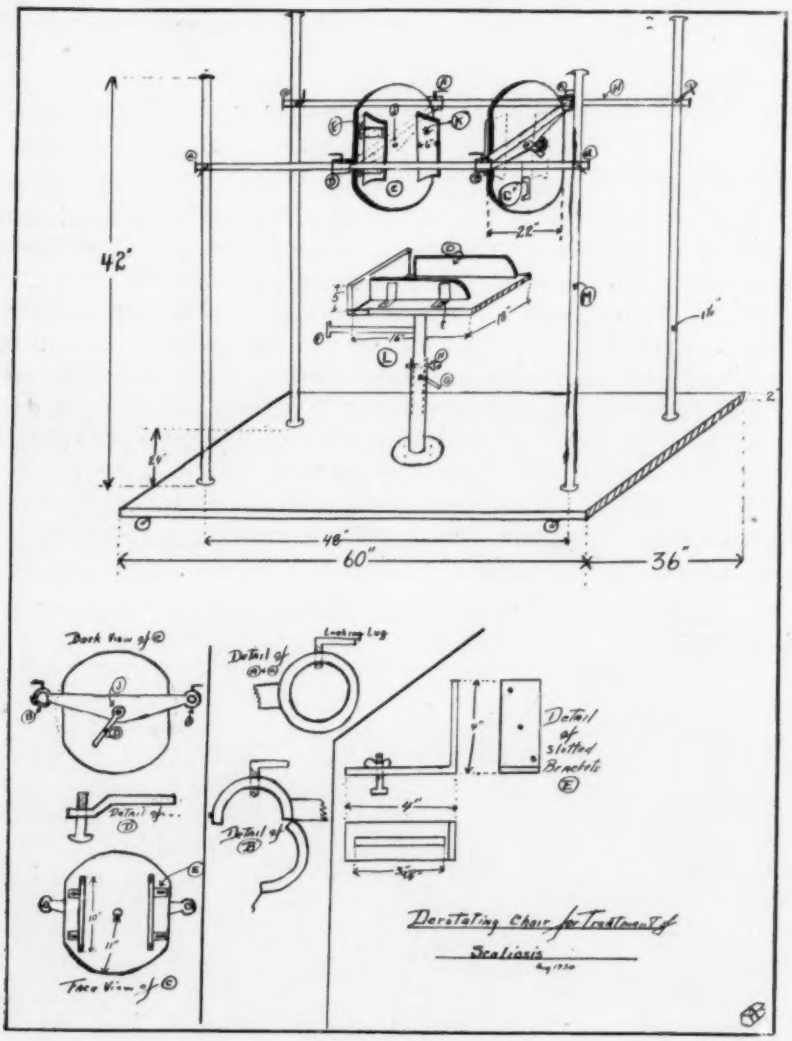

FIG. 1

This apparatus consists of a platform, sixty by thirty-six inches, mounted on casters. Upon this platform is a chair, on which the patient sits, and four uprights connected in pairs by horizontal bars. These bars are, in turn, connected by cross-members upon which are mounted vertical swivel platforms with side-arms, between which the upper part of the patient's body can be encased.

The chair (*L*) is adjustable in height by altering the position of the pin (*N*), and can be rotated in either direction by use of the handle (*F*). When rotated to the desired angle, the position can be maintained by tightening the lock-bolt (*G*). In order that patients of any size may be treated, the seat of the chair is made adjustable in width, the side-arms (*O*) being mounted on right-angle brackets (*E*) which are slotted as shown in the diagram. A thumb nut is used to fasten the side-arms in the desired position. These side-arms are of such height that they fit against the patient's thighs and hips and prevent the patient from turning in the chair.

The uprights (*M*) are of such height that the wings (*K*) of the swivel platforms (*C*) can be made to fit snugly under the armpits of the patient. The connecting bars are adjustable in height and are locked in position by the use of locking lugs (*a*).

The swivel platforms are mounted upon the cross-members by a central bolt (*J*) and they can be rotated about this bolt to produce any desired amount of overcorrection of curvature. When this is obtained, the lever nut (*D*) can be tightened, which will lock the swivel in the overcorrected position. The cross-members are mounted so as to slide along the connecting bars, and can be locked in position. The method of mounting is shown in the enlarged diagram of *C*. The open mounting (*B*) permits the cross-member to be swung up so that the patient will have easy access to the chair. The wings (*K*) are adjustable in the same manner as the side-arms of the chair.

Approximate sizes are given for all parts of the apparatus.

The patient is seated in the chair, the side-arms fitted against the thighs; the swivel platform (*C*) placed against the patient's back, and the wings under the armpits. The second swivel platform is then slid against the chest, the two pairs of wings coming together to hold the thorax. The patient's arms are extended along the connecting bars (*H*). With the body locked between *C* and *C'*, and the thighs between the side-arms of the chair, any amount of derotating may be produced by swinging the chair in the desired direction. When this has been obtained, correction of the scoliosis may be produced by rotating the swivel platforms. Since the connecting bars (*H*) are adjustable, differences in height of the shoulders can be accommodated by raising or lowering one or the other of the bars.

The chair, as described, has fulfilled the present needs. Later alterations and refinements may be necessary.

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"SAM BROWNE" BELT FOR RIB FRACTURES

BY ROBERT V. FUNSTON, M.D., DETROIT, MICHIGAN

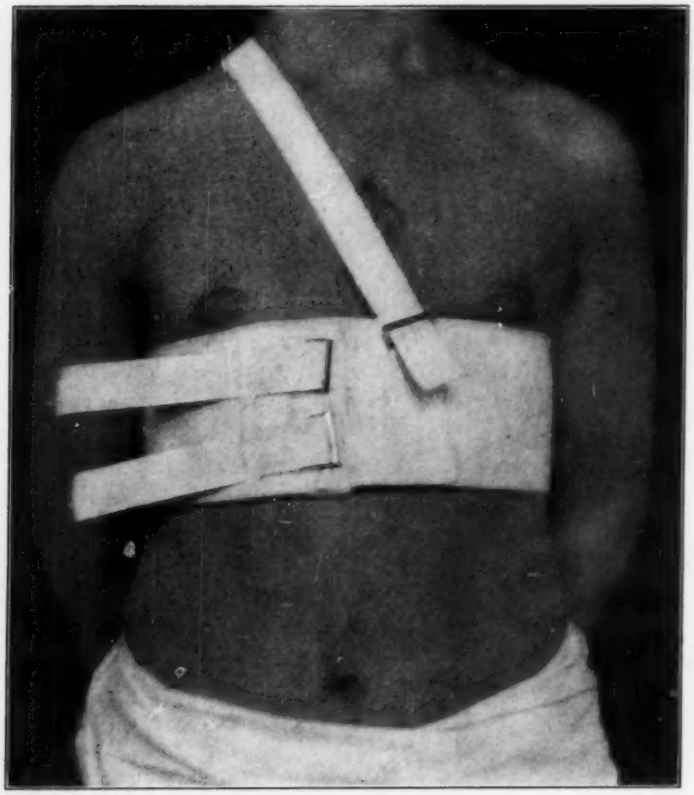

Fig. 1

In the treatment of fractures of the ribs, the use of adhesive strapping often becomes irritating to the skin. In its place a fashioned canvas binder with a shoulder strap, similar to the "Sam Browne" belt, has been used.

This apparatus has proved both efficient and very comfortable to the patient.

AN ATTACHMENT TO THE HAWLEY TABLE FOR FIXATION OF THE LOWER EXTREMITIES

BY H. EARLE CONWELL, M.D., F.A.C.S., FAIRFIELD, ALABAMA

Orthopaedic Clinic, Employees' Hospital

This attachment, as shown in accompanying illustrations, is to be used as an adjunct to the excellent devices which have been described as canvas hammock supports. These supports are for the purpose of holding the

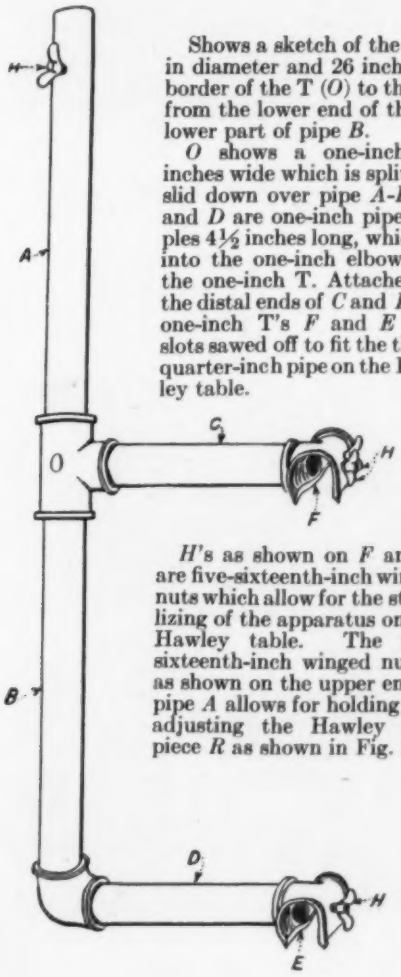

FIG. 1.

Shows a sketch of the apparatus. *A-B* is a single piece of pipe 1 inch in diameter and 26 inches long. *A* is 11⅞ inches long from the upper border of the T (*O*) to the upper end of pipe *A*, and *B* is 11⅛ inches long from the lower end of the T (*O*) to the one-inch elbow that fits into the lower part of pipe *B*.

O shows a one-inch T 3 inches wide which is split and slid down over pipe *A-B*. *C* and *D* are one-inch pipe nipples 4½ inches long, which fit into the one-inch elbow and the one-inch T. Attached to the distal ends of *C* and *D* are one-inch T's *F* and *E* with slots sawed off to fit the three-quarter-inch pipe on the Hawley table.

H's as shown on *F* and *E* are five-sixteenth-inch winged nuts which allow for the stabilizing of the apparatus on the Hawley table. The five-sixteenth-inch winged nut *H* as shown on the upper end of pipe *A* allows for holding and adjusting the Hawley foot piece *R* as shown in Fig. 2.

FIG. 1.

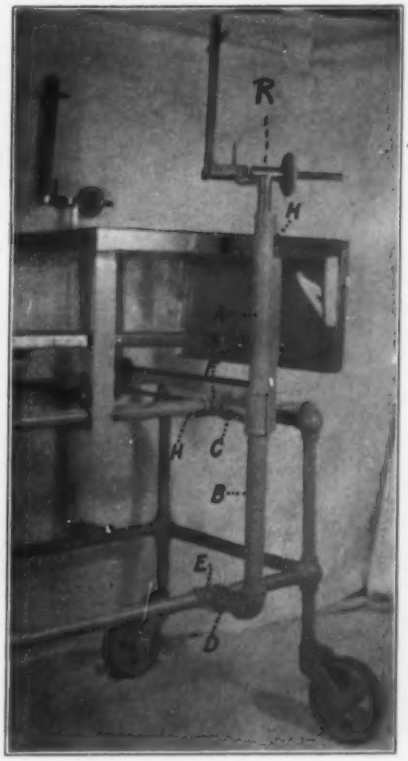

FIG. 2

Shows the apparatus applied to the Hawley table with the Hawley foot piece *R* firmly fixed in the upper end of pipe *A* by the winged nut *H*.

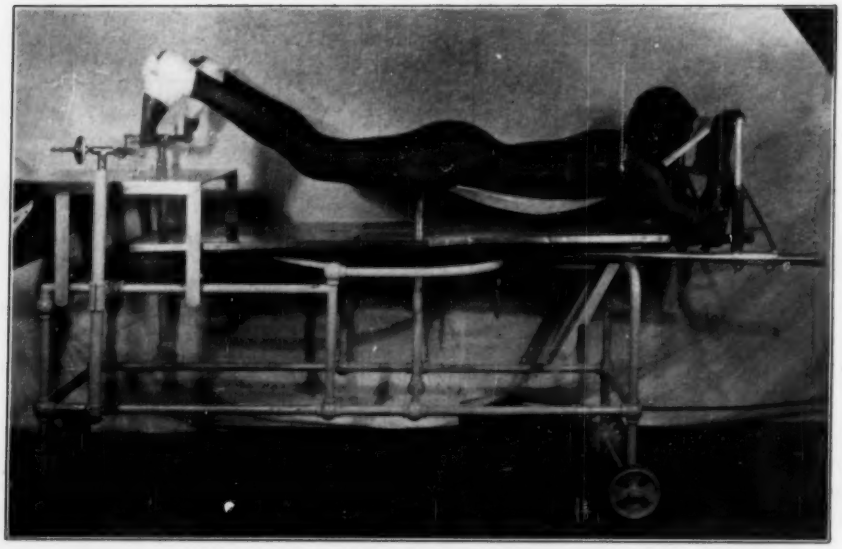

FIG. 3

Shows full body view of the patient in Silver's canvas hammock support with the feet being held in place by the one-inch pipe apparatus.

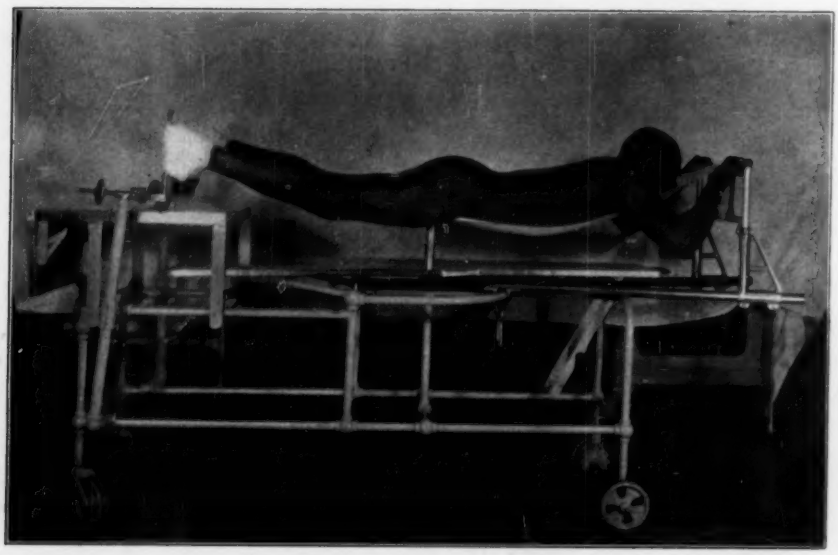

FIG. 4

Another view of the patient fixed on the Silver canvas hammock support, and patient's lower extremities being held in place by the one-inch pipe apparatus. Any amount of extension of the spine can be accomplished by raising or lowering the Hawley foot pieces in the upper end of the one-inch pipe apparatus.

patient's body in a prone position while the back is in extension, when applying plaster body casts or other supports or treatment.

The author experiences great difficulty in fixing the lower extremities when using any of the above hammock supports, especially where it becomes necessary to apply plaster spicas to the hips extending down the thighs or to the ankles and feet, either in the adolescent or in the adult.

In compressed fractures of the spine where it is very necessary that the back be in an extended position, and also where it is very important to have as complete fixation and immobilization of the body as possible, the author has found that this attachment to the Hawley table is very useful. It enables one not only to keep the patient in a rigid fixation and immobilization, as well as to control the degree of extension of the spine, but also allows for the extension of the plaster down the thighs and legs when necessary.

A CORRECTIVE SUPPORT IN SCOLIOSIS

BY C. W. PEABODY, M.D., DETROIT, MICHIGAN

From the Clinic and Hospital School of the Sigma Gamma Association for Crippled Children

During the last few years, the writer has found the apparatus here described of especial value, and more satisfactory than anything heretofore tried in the management of structural scoliosis. It does not represent any new principle, but is rather a combination of the effective and desirable features of several types of support, avoiding at the same time many objectionable features of retentive devices. Experience with various types of posterior support, with the so called cage type of skeletonized body brace, including that of Klein (Massachusetts General Hospital), and with leather and celluloid jackets, has led to the evolution of the present apparatus.

In our analysis of the problem it appeared that the essential desiderata in a scoliosis support might be: (1) a comfortable yet positive grip and foundation on the pelvis; (2) sufficient rigidity in this base to carry uprights capable of withstanding lateral stress, at a corrective angle; (3) provision for pressure or traction on the major rib deformity; (4) freedom of all other areas from constriction; (5) sufficient leverage to correct or resist total inclinatory deviation or shift.

The above essentials have seemed to be rather effectively yet comfortably met in the device here illustrated: A base is provided by an accurately molded pelvic girdle of celluloid (*A*, Fig. 2), which has the rigidity lacking in leather and a greater degree of comfort than the butterfly base of the steel cage brace. Anterior and posterior lateral steel uprights (*B*, Figs. 2 and 3) are erected on this base on the side opposite the major curve (being also at the side away from the total list), and erected at such an angle to the base as will correct the list when the thorax is pulled toward the upright members. The posterior upright stays clear of the rib concavity on its side and is in contact with the thorax only at the top. The anterior upright bears against the rib convexity in front. A traction cuff (*C*, Fig. 2) from the uprights bears against the major rib convexity behind and exerts lateral pressure opposite to the middle of the major (upper) curve, at the same time drawing the thorax *in toto* in the opposite direction

FIG. 1

Structural curve with overhang to right. Compare with Fig. 2.

FIG. 2

Apparatus applied to case in Fig. 1. Note countershifting and apparent decrease of major curve.

FIG. 3

Anterior view of appartus.

FIG. 4

Structural curve with bad list and overhang. Patient standing in utmost voluntary correction after long training.

FIG. 5

Apparatus with addition of hip abduction attachment (Steindler), showing maximum possibilities of countershifting. (Compare with Fig. (4.)

FIG. 6

Front view of Fig. 5.

from the total displacement or shift, thus allowing for correction by compensation. The two traction straps in front (*D*, Fig. 3) are placed high and low, thus avoiding pressure on the anterior rib concavity. There prevails no circular constriction of the chest or upper abdomen. A pad under the upper edge of the celluloid girdle behind bears against the lateral processes at the lower curve. A second pad is usually necessary to fill up the lateral gluteal hollow on the opposite side and thus furnish a more effective bearing point for the countershifting leverage. The tops of the uprights are connected on the one side only by a cross piece passing under the axilla and rising high enough to supply adequate leverage at this end, as well as a bearing point near the upper end of the major curve, incidentally elevating the low shoulder by the crutch support. The high shoulder remains entirely free and unsupported, as its weight should have a corrective effect on the upper curve.

Where the total displacement or shift requires a longer leverage below the pelvis, or when countershifting of the pelvis on the heels can be secured only by abduction of the hip, there is added a jointed steel member (*F*, Fig. 5) at the side of the hip, secured on the pelvic girdle above and to a legging on the thigh (*E*, Figs. 5 and 6). The latter can also be made of

FIG. 7

Hopeless razor-back curve with steadily increasing overhang. Recumbent most of time through pain and inability to wear any resistant apparatus and maintain general condition.

FIG. 8

Case shown in Fig. 7. Reporting complete comfort after six months' use, with increasing activity, marked general improvement, and gain in weight. The upper posterior strap from cuff has stretched and cuff is shown a little too low.

celluloid, but is easier on the clothing and more comfortable if made of leather.

The apparatus thus described and illustrated is quickly removed and reapplied in the gymnasium and is not difficult of proper adjustment by the patient, particularly if the holes in the straps producing the desired tension are marked for the child by the surgeon. It is very well tolerated in hot weather. Alterations to follow progressive correction are easily made as progress in countershifting and elongation of trunk occurs, since the uprights are secured to the celluloid by short wood screws, easily removed and replaced by the surgeon when it is desired to elevate the uprights or shift their angle.

This device was originally utilized to follow up forcible correction by plaster jackets. However, as its progressive corrective possibilities became obvious, it has largely replaced cast treatment and seems to adapt itself well to the scheme of management of scoliosis advocated by Steindler. In fact the favorable interest of several surgeons, much more experienced in this problem than the writer, has encouraged this report.

News Notes

The Forty-fifth Annual Meeting of the American Orthopaedic Association will be held in Memphis, Tennessee, April 15 to 18, 1931.

At the Hospital for Joint Diseases, on Thursday evening, January 8, a lecture is to be delivered by Dr. Arthur Steindler, of Iowa City, Iowa, on "Mechanics of Upper Extremity Contractures".

Dr. Charles E. Sevier and Dr. Atha Thomas announce their association in the practice of bone and joint surgery. Their office is located in the Republic Building, Denver, Colorado.

Dr. Fred H. Albee has moved his office to 57 West 57th St., New York City.

Dr. Seth Selig has moved his office to 18 West 82nd Street, New York City.

Dr. Theodore E. Orr announces the removal of his office to 2001 Aldine Building, 1930 Chestnut Street, Philadelphia, Pennsylvania.

Dr. Isadore Zadek announces that he has moved his office to 1095 Park Avenue, New York City.

Dr. William Tate Graham and Dr. Donald McKenzie Faulkner announce the association with them of Dr. James Thomas Tucker. Their offices are in the Medical Arts Building, Richmond, Virginia.

The New Auditorium of the Orthopaedic University Clinic in Berlin was dedicated on November 10. The **Berline orthopädische Gesellschaft** held its first session of the year 1930–1931 in the new Auditorium.

The Hospital for Joint Diseases announces six appointments on their House Staff, for two years' rotating service, three to begin July 1, 1931, and three to begin January 1, 1932. At the completion of the two years' service, graduating interns are eligible for The Frauenthal Travel Scholarship for $2,400 a year, for six months' study in the leading Clinics in Europe, and six months' study in the United States; and The Mr. and Mrs. Frederick Brown Research Fellowships, providing an award of $2,400 to each of two successful candidates.

The Journal regrets to record the death of Dr. S. J. Hunkin, so long prominent in the practice of orthopaedic surgery in the West. Dr. Hunkin was one of the pioneers in orthopaedic surgery on the western coast, and held many positions of prominence and importance. He died in San Francisco, on October 11.

Dr. Henri Delagénière, of Le Mans, France, died September 30, 1930. He was well known in France, and had served as President of the Surgical Congress. He was particularly interested in the problem of the osteoperiosteal graft, and due to his efforts this method was adopted by the French surgeons during the World War.

Dr. Cyrus Newton Callander, who was one of the pioneer physicians of North Dakota, died on July 30. During the last fifteen years, Dr. Callander had confined his practice to orthopaedic surgery, being associated with the Fargo Clinic. He was greatly interested in his specialty, and eager to contribute to its progress. During the past few years he has been associated with his son, Dr. C. Latimer Callander, of San Francisco, in the preparation of a text on "Regional Anatomy", laying especial emphasis upon the surgery of the different regions.

On Tuesday evening, November 18, there was held in the auditorium of the Hospital for Joint Diseases, New York City, a meeting of the Clinical Society of the Hospital, which took the form of a memorial service to Dr. Walter M. Brickner, who died on July 22, 1930. Dr. Brickner was Chief Surgeon of the Hospital for Joint Diseases, and therefore such a service in recognition of his work for the hospital was most fitting. The program was as follows:

Eulogies:

Ignac Neumann, M.D.
Howard Lilienthal, M.D.

Contributions to Medical Science:

General Surgery. Philip M. Grausman, M.D.
Subacromial Bursitis. Samuel Kleinberg, M.D.
Osteomyelitis. Harry Finkelstein, M.D.
Neurological Surgery. Louis Carp, M.D.

The Annual General Meeting of the **British Orthopaedic Association** was held in London on November 28 and 29. The program was as follows:

Friday, November 28

Morning Session at The Royal Society of Medicine.
Annual General Meeting.
Presidential Address: Pathology in Relation to Orthopaedic Surgery.
Discussion on: Fractures of the Lower Extremity (illustrated by cinematograph and lantern slides). Opened by Dr. Lorenz Böhler, of Vienna.
Afternoon Session at King's College Hospital.
Operations and Clinical Demonstrations.
Evening.
Association Dinner at The Langham Hotel.

Saturday, November 29

Morning Session at the Royal Society of Medicine.

Some attempts at Stabilization of Pathological Dislocations of the Hip. By D. McCrae Aitken.

Open Operation for Congenital Dislocation of the Hip. By H. A. T. Fairbank.

Afternoon Session.

Luncheon at the Zoological Gardens by invitation of the President.

Exhibition of pathological specimens by Colonel Hamerton, Pathologist to the Zoological Society.

The fall joint meeting of the **Northern** and **Southern Orthopaedic Societies** took place in Los Angeles on November 8.

The morning was occupied by a clinic at the Children's Hospital, where the Staff presented a series of orthopaedic problems, all in the nature of end-result studies. The presentations were enthusiastically received. The Children's Hospital was host for luncheon.

In the evening, the meeting was held at the Orthopaedic School. After an inspection of the new clinic which has recently been opened, featuring especially the under-water gymnasium, dinner was served in Memorial Hall.

Dr. E. C. Bull, of San Francisco, presented the paper of the evening, the subject being "Some Observations on Bone Lengthening".

The attendance of this meeting was the largest in the history of the clubs.

The Twenty-fourth Annual Meeting of the **Southern Medical Association** was held in Louisville, Kentucky, November 11 to 14. Of special interest to orthopaedic surgeons was the paper on "Supracondylar Fractures of the Elbow" presented by W. B. Carrell, of Dallas, Texas, at the General Session on November 12.

The Section on Bone and Joint Surgery held its sessions on Thursday and Friday, November 13 and 14. The hosts were Dr. W. Barnett Owen, Dr. Orville Miller, and Dr. Frank Strickler. An interesting program had been arranged by the Committee, which was presented as follows:

Flat Feet. Dr. Harold R. Bohlman.

Syphilitic Arthritis. Dr. E. S. Hatch.

Sympathectomy in Arthritis. Dr. Philip S. Hench.

Unusual Congenital Deformities. Dr. T. B. Clegg.

Sarcoma of Spine: A Cured Case. Dr. H. Theo Simon.

Fractures of Shoulder: Methods and Results. Dr. W. K. West.

A New (Plaster Yoke) Dressing for Fracture of Clavicle. Dr. R. W. Billington.

Fracture of the Neck of the Femur. Dr. E. D. McBride.

Chairman's Address: A Review of the Operations for Recurrent Dislocation of the Shoulder and a Report of End Results. Dr. George E. Bennett.

Fusion of Sacro-iliac Joint—motion pictures. Dr. Willis C. Campbell.

Spondylolisthesis with Special Reference to the Industrial Case. Dr. J. Edgar Stewart.

Dr. F. C. Kidner, of Detroit, Michigan, and Dr. A. W. Adson, of the Mayo Clinic, Rochester, Minnesota, were guests of the Section.

The following officers of the Bone and Joint Section were elected for the coming year:

Dr. O. L. Miller, Charlotte, N. C., Chairman.

Dr. Lawson Thornton, Atlanta, Ga., Vice Chairman.

Dr. A. F. Voshell, University, Va., Secretary.

The meeting in 1931 will be held in New Orleans, Louisiana, November 17 to 20.

The nineteenth annual meeting of the **Clinical Orthopaedic Society** was held at Toledo, Ohio, and Columbus, Ohio, on October 31 and November 1.

The morning session on October 31 was held at St. Vincent's Hospital, Toledo. Interesting cases were presented by: Dr. Barney J. Hein, Dr. Thomas H. Brown, Dr. B. G. Chollett, Dr. A. L. Bershon, Dr. Dale Wilson, Dr. Lewis R. Carr, Dr. Rudolph Diethelm, Dr. N. J. Seybold, Dr. J. T. Murphy, and Dr. Clarence Hufford.

The afternoon session was held at the Toledo Hospital, where cases were presented by: Dr. Elmer McKesson, Dr. B. Steinberg, Dr. M. Goodrich, Dr. Thomas H. Brown, Dr. Barney J. Hein, Dr. Dale Wilson, Dr. B. G. Chollett, Dr. A. L. Bershon, and Dr. Lewis Carr.

In the evening a joint meeting was held with the Academy of Medicine of Toledo and Lucas County at the Academy of Medicine Building. The address of the evening was by Dr. J. T. Murphy, on the subject of "Bone Tumors".

The program on November 1 was given at the Children's Hospital in Columbus. After the welcome by Dr. J. H. J. Upham, Dean of the Medical School of Ohio State University, interesting cases were presented by: Dr. Donald Bowers, Dr. A. Steinfeld, Dr. E. H. Wilson, Dr. Cassius Shepherd, Dr. Judy, and Dr. Rankin.

The officers elected for the coming year were as follows:

Dr. R. B. Cofield, Cincinnati, Ohio, President.
Dr. B. G. Chollett, Toledo, Ohio, Vice President.
Dr. E. B. Mumford, Indianapolis, Ind., Secretary-Treasurer.

The annual meeting of the **Robert Jones Orthopaedic Club** was held on November 5, 1930, at Charlottesville, Virginia, and on November 6, 7, and 8, at Richmond, Virginia.

At Charlottesville a very interesting program was provided by Dr. Allen Voshell and by the University Hospital Staff of the University of Virginia Medical School.

On Thursday, November 6, the following program was provided by the members of the Staff of the Johnson Willis Hospital:

The Injection Treatment of Varicose Veins. Dr. Donald Daniels.
Thoracoplasty in Tuberculosis. Dr. F. S. John.
Paget's Disease. Dr. Daniel Talley.
Cardiac Displacement. Dr. J. M. Hutchinson.
Osteomyelitis of the Spinous Processes of the Vertebra. Dr. R. L. Anderson.

On Friday, November 7, the following program was provided by the Staff of the Memorial Hospital:

The Injection of Air in the Treatment of Gonorrhoeal Arthritis. Dr. W. L. Porter.
Treatment of Spinal Cord Injury. Dr. C. C. Coleman.
Spasmodic Torticollis. Dr. C. C. Coleman.
Deforming Conditions of the Joints in Childhood. Dr. A. L. Gray.
Injury of the Blood Vessels. Dr. Paul Laroque.

On Saturday, November 8, the meeting was held at the Crippled Children's Hospital. Of special interest was the address by Dr. H. Page Mauck on "Treatment of Acute Knee Injury". The speaker has had a large experience in the treatment of severe ligamentous injuries of the knee joint. After anatomic investigation upon the cadaver and experimental work with animals, he adopted the method which he has since employed of treating such knees by aspiration at the end of forty-eight hours, and the application of an unpadded plaster casing in two sections, one to the leg and one to the thigh, and joined together by side steels jointed at the knee. These protected against lateral mobility, and at the same time permitted function. The patients were permitted to walk almost immediately, and returned to school in a short time. He had treated 137 cases by this method, of which sixty-two had been followed over a period of three to ten

years. The results were contrasted with those of a smaller group of cases which had been treated by the usual methods of fixation. The statistics indicated that the results were much improved with the hinged plaster method of treatment. Of interest were seven cases of fracture of the tibial spine which had been treated by this method, likewise with success.

Dr. R. L. Anderson reported a very interesting case of infracotyloid dislocation of the hip in a child of six in whom, as the result of a fall on the right knee, the femoral head had been dislocated below the acetabular margin, and the hip fixed in right-angle flexion. The speaker discussed the condition, and pointed out that it was the first step in all dislocations, but that the femoral head rarely remained there.

A number of interesting cases were presented by Dr. W. R. Graham, including one of transplantation of the fibula to replace the tibia, and two of silk substitution in cases of tendon injury.

Other interesting cases presented were:

Unusual Case of Ununited Fracture of the Upper End of the Femur. Dr. J. B. Dalton.

Vaccine Treatment in Chronic Arthritis. Dr. W. R. Graham.

Epiphysitis. Dr. J. Blair Fitts.

Ewing's Tumor. Dr. J. Tucker.

Fusion of the Hip for Tuberculosis. Dr. Donald Faulkner.

The International Orthopaedic Society held its first scientific congress at the University of Paris, the Sorbonne, October 2 to 4, inclusive. Sir Robert Jones, the President, was in the chair. Various countries of the world were represented.

The scientific session consisted principally of two symposia, for which reporters had been previously selected. The titles of these symposia were: (1) Treatment of Congenital Dislocation of the Hip at Fifteen Years of Age and Beyond; (2) Treatment of Trauma of the Wrist.

The following officers were elected:

Sir Robert Jones, Permanent President.

Dr. Nové-Josserand, of France, President of next Congress.

Dr. Murk Jansen, of Holland, Vice President.

Dr. Maffei, of Belgium, Treasurer.

Dr. Delchef, of Belgium, Secretary.

Dr. Fred H. Albee, Chairman, and Dr. Wm. S. Baer and Dr. H. Meyerding were re-elected on the National Committee of the United States.

The next congress of the Society is to be held in London in 1933.

The first subject considered was: The Treatment of Congenital Dislocations of the Hip after the Fifteenth Year.

Mr. Lothar Kreuz, of Berlin: On a basis of physiological considerations, the author discussed the different methods available in old congenital dislocations of the hip. He divided them into two main groups: (1) the methods which attempt restitution of the dislocated head into the socket,—the optimum result of these methods is physiological cure; (2) the methods which renounce the restitution of the dislocated head, but which instead aim at a sufficient support of the pelvis and satisfactory function of the dislocated joint,—the result in this group is a patho-physiological cure.

He finds a physiological cure by bloodless reduction of the first group is practically never obtainable after the fifteenth year, and that even with open methods only patho-physiological results will be obtained.

The bloodless procedures confine themselves principally to apparatus therapy, which have a very limited indication. The open methods are the following: the transpositions, the pseudarthrosis operation of Hoffa, the deep subtrochanteric osteotomy of Schanz, and the bifurcation operations of von Baeyer, Kirmission, and Lorenz. The

transpositions have the disadvantage of the danger of infection and the uncertainty in degree and duration of the curative effect. Similar disadvantages are attached to pseudarthrosis operations. The bifurcation is, in the opinion of the author, the best method with this type of dislocation. The scope of the bifurcation is to create, on the dislocated side, a passive bony support of the pelvis in or at the level of the acetabulum, and, at the same time, to produce an active grip upon the pelvis by restoring physiological tension and direction of the gluteus medius and minimus muscles. The operation differs principally from the deep subtrochanteric osteotomy of Schanz in that the latter produces only the passive support of the pelvis.

By plastic models, the author showed the manner in which the support of the pelvis is produced. The fact that the direction and tension of the gluteus muscles approach normal values, manifests itself in that the pelvis, after operation, no longer drops toward the sound side, and that the Trendelenburg symptom disappears. The higher the support of the distal fragment against the acetabulum is placed, the greater is the obstacle to adduction, and it is difficult to decide whether the disappearance of the Trendelenburg symptom is due to passive bony block of the adduction movement, or whether it is due to active physiological muscle action. If it is due only to bony block, then the persistence of sufficient pelvic support becomes doubtful and we see that the artificially created femoral angle stretches itself in the course of years. To this must be added a pathological genu valgum or a physiological genu valgum in females, which forces the supporting surface of the foot outside of the mechanical longitudinal axis of the leg and thereby impairs the persistence of the angle and the adduction check produced by the lower fragment. It is, therefore, desirable to prevent in those cases the gradual stretching of the bifurcation angle by adduction correction of the genu valgum deformity.

The speaker emphasized that in bilateral cases, as long as the range of motion of the operated hip cannot be foreseen definitely, simultaneous operation on both hips should be avoided, and a second operation should be undertaken only after a satisfactory freedom of motion has been developed in the first joint.

Dr. F. Gaenslen, of Milwaukee (Paper read by Dr. Dickson of Kansas City): The number of patients over sixteen years of age, with congenital dislocation of the hip, who complain of pain and disabilities is small, and the author found the ratio in his private cases to be *one* out of 1,000 of all cases.

In the two-stage operation of Allison, the contracted anterior portions of the capsule are divided in the first step, and the lesser trochanter is sectioned to eliminate the obstacle of the psoas muscle. Then follows a three-week period of skeletal traction and, in the second step, the acetabulum is cleared and the head is replaced.

Of the palliative operations, the author mentions the shelf operation for cases in which the head cannot be brought down safely to the level of the acetabulum. This operation is gradually gaining favor, especially since Dickson's report of 1924.

Better and more numerous reports are coming in regarding the subtrochanteric osteotomies and bifurcation operation. It is especially useful for the group under consideration in which the anatomical changes are so great that restitution to anything like normal is quite out of the question. In these cases the operation secured satisfactory functional result with comparatively little risk. Nevertheless, the author refrains from comparing the respective values of the shelf operation and the palliative ostetomies until there has been a much larger experience.

Mr. Fairbank of London: The opinions in Great Britain are divided as to whether or not the painless case over fifteen should be operated upon. Only a minority of surgeons operate in selected cases, the indications being marked lordosis, adduction deformity, and bad limp. For these, subtrochanteric osteotomy and sometimes bifurcation operation are the usual procedures. Most surgeons think that secondary arthritis is responsible for the adduction deformity, and that any final result is invariably vitiated by arthritis.

For the painful case, the speaker advocated arthrodesis as the only certain cure, although other British surgeons recommend also the osteotomies. In arthrodesis the new socket for the femoral head should be placed as near as possible to the true acetabulum. In the presence of arthritis it is questionable whether relief can be obtained by osteotomy alone. Only when pain is due to the strain of soft parts, especially in lumbar pain associated with excessive lordosis, may osteotomy give relief. Excision of the femoral head gives only temporary relief. The shelf operation is rarely performed in Great Britain; in the presence of arthritis, this operation also gives only temporary benefit.

When both hips are equally painful, osteotomy is the best procedure.

Dr. Vittorio Putti of Bologna: The author believes that the time limit for physiological cure is twelve years of age. In the treatment of the inveterate congenital dislocation he distinguishes two periods: (1) from the twelfth to the twenty-second year; (2) from the twenty-second year on. Aside from this, the point of unilaterality or bilaterality is of deciding and determining importance.

In the period from 1899 to 1923, there were treated in the Istituto Rizzoli 138 cases of congenital dislocation of the hip in patients over twelve years old, and of these cases seventeen were bilateral; so that the total number of dislocations over twelve treated was 155. He distinguished between the treatment of the unilateral and that of the bilateral cases. In the first group,—that is the unilateral cases,—a further distinction is made according to age,—namely, from the twelfth to the twenty-second year, and beyond the twenty-second year.

The author distinguished in the treatment the attempts at bloody and bloodless reduction and reconstruction of the acetabulum. He further discussed the transposition, the arthrodesis, the subtrochanteric osteotomy, the removal of the epiphysis, the arthroplasty, the bifurcation, and the prosthesis.

Unilateral Dislocation. Age Twelve to Twenty-two.

Bloodless and Operative Reduction. The speaker stated that in properly selected cases, it is sometimes possible to accomplish reduction, by open or closed methods, even in individuals up to seventeen or eighteen years of age. Still, when the end results of these belated reductions are considered, one finds usually the same situation,—either redislocation or rigidity, followed by adduction contracture, or even ankylosis. The few cases in which better results were reported do not justify the use of the reduction treatment as a routine method.

On the other hand, there are sometimes at the age of twelve, and often much earlier, absolute contra-indications to reduction, as in delicate individuals or lymphatic patients.

The Reconstruction of the Hip Socket. He finds that this method is thoroughly justified in cases of subluxation, and his results in these cases were entirely satisfactory. In cases of reduced dislocations, whether reduced by open or closed method, the results of subsequent acetabular reconstruction are at first good; however, after a few months, the joints show marked tendency to rigidity and contraction.

Results: anatomic, two good, six moderate, seven poor; functional, eight good, five moderate, and two poor,—among a total of fifteen cases observed from eight to twenty-four years. In eighteen cases of this type results were as follows: anatomic, three very good, four good, eight moderate, three poor,—total eighteen; functional, three very good, ten good, two moderate, and *three* poor. In six cases, observation time from eight to twenty-eight years, the end results were as follows: anatomic, two moderate, four poor; functional, two good, two moderate, and two poor.

Unilateral Dislocations—Second Period. Twentieth to the Twenty-second Year.

The operative treatment involves the following methods: transposition, reconstruction of the acetabulum, arthrodesis, subtrochanteric osteotomies, Hoffa's removal of the epiphysis, arthroplasty, the Lorenz bifurcation, and the osteotomy of Schanz.

Transposition is used to improve the mechanics of the articulation. Many sur-

geons avail themselves even now of this method. Among these are Nové-Josserand, Froelich, Galeazzi. Although this method is indicated principally in the juvenile age, it is occasionally applicable to the older cases, and especially are the results observed by Nové-Josserand favorable. Still, the author believes that here also the joint meets with a similar fate,—namely, rigidity, deformity, and painful reaction.

As to the results, the author reports three cases, operated by Codivilla. Of these the results were good twenty years after operation in two; in the third case, bilateral, they were functionally satisfactory.

The Reconstruction of the Acetabulum: Already in 1891, König advised plastic reconstruction by bone flap from the os ilium. The author believes that the method should be limited to subluxations, to old congenital reduced dislocations, to the paralytic dislocations, and to the pathological dislocations.

The Arthrodesis: The author advocated this operation in unilateral dislocations with marked displacement, little mobility, great tenderness, where the x-ray picture shows grave destruction of the epiphysis and evidence of bone attrition, in individuals from twenty-five to thirty-five years in whom the other hip is in good functional condition.

In nine cases the method was carried out by the process of operative freshening of the ends. Of the eight cases in which the end results were known, one was decidedly poor, while seven were very satisfactory.

The Subtrochanteric Osteotomy: This method is especially indicated where a certain articular rigidity exists, especially in flexion and adduction contracture. If an oblique osteotomy after Kirmisson is carried out, the corrective angle of the osteotomy may produce a much better pelvic support. The subtrochanteric osteotomy has the advantage of being feasible in all ages, of involving little traumatism, and of not demanding long postoperative treatment.

Of eight cases operated by this method, three were under twenty, and five were over forty years of age. In general, the indications were flexion and adduction contractures. In all cases the result was satisfactory and permanent.

The Removal of the Epiphysis According to Hoffa: This is indicated in cases of attrition, ulceration, and destruction of the head with formation of a hypertrophic osteophytic secondary socket. If the age of the patient and his general condition permit a more radical interference, the operation may also be carried out in bilateral cases.

The author has carried out this operation in four instances, and gave the end results in two,—one twenty-six years and one twenty years after operation—which were satisfactory in both, inasmuch as the pain disappeared. In still another case—bilateral—the end result in the twelve-year-old patient was poor.

The Arthroplasty: The operation is confined to those cases in which reduction is still possible, the dislocation is not extreme, and the anatomic condition is favorable. It is indicated particularly in individuals from twenty to thirty-five years in good general condition, although it is also indicated in certain cases of unreduced dislocations. For interposition, a double layer of fascia lata is recommended. In this connection, there is also mentioned the reconstruction method of Whitman which meets similar indications.

Of ten cases operated by arthroplasty, the author gave the results in five: They were very good in one case, operated four years previously for severe arthritis deformans in a subluxated hip; good in two cases, secondary socket, five years after intervention; and moderate in two cases, two years after operation.

Lorenz' Bifurcation Operation: This method was given by Lorenz almost contemporaneously with that of v. Baeyer. It is important that the osteotomy be placed at the proper level,—*i.e.*, at the level of the acetabulum—and that the osteotomy line be in oblique direction in the frontal plane (an angle of thirty to forty degrees).

The author has carried out the bifurcation operation in thirty cases,—twenty-four unilateral and six bilateral, or a total of thirty-six hips. Twenty-one cases so operated and observed at long intervals over two years all gave satisfactory results.

Schanz' Osteotomy: Here, the author reported no personal experience.

Bilateral Cases.

The author repeated that in cases over twelve it is a fundamental error to attempt reduction. Furthermore, with the exception of a few cases in which a palliative treatment of both hips is advisable, one should operate upon only one hip. Even before the fifteenth year, bilateral cases may result in a rigid, contracted, and painful articulation, and with the advancing years recurrence of contracture and pain is the rule. It is these cases in which the Lorenz osteotomy finds its most precise indication. The bifurcation is up-to-date, and the only surgical procedure capable of producing a permanent, stable condition in these cases. Very often, in bilateral dislocations, one finds one side movable and only slightly painful, whereas the other side shows a subluxation and arthritis deformans,—this is usually the side which causes the most trouble. In those cases one may resort to immobilization under anaesthesia or, better, to subtrochanteric osteotomy of the painful side, to correct the deformity and to give better alignment.

Prof. Ombredanne, of Paris, considers operation indicated for the anterior dislocations only exceptionally,—never for the limp, but only for pain. For the posterior dislocations also, he operates for pain only. The operation consists of reduction of the head, with shelving, if necessary; sometimes, also resection and shelving, or resection of the shaft and shelving.

Prof. Nové-Josserand, of Lyon, confined himself to the conservative treatment of inveterate cases. He never attempts open or closed reduction after the fifteenth year, but performs osteotomy and shelving or a reconstruction of the socket in younger children. In high dislocations and posterior dislocations he prefers the new osteotomy of Schanz, although he has also obtained good results with Lorenz' osteotomy. If the shortening is about four centimeters, he prefers the transposition to intertrochanteric osteotomy, as this gives no further shortening.

Dr. Pagliano, of Torino, showed slides with cases of high dislocation in which the subtrochanteric osteotomy of Schanz has given good results.

Dr. Richard Scherb, of Zürich, emphasized the individuality of the case. He pointed out that function of the limb should be examined not in standing only but also in walking. Especially does one gain valuable information on the varied function of the gluteal muscles by examination by the treadmill.

Dr. Julius Hass, of Vienna, reported 120 cases of the Lorenz bifurcation operation, which were observed over a period up to fifteen years. He pointed out that perfect results can be expected only when one succeeds in placing the point of the lower fragment directly in the acetabular cavity.

Dr. R. B. Osgood, of Boston, emphasized the problem of the unilateral procedure. He is an advocate of preliminary traction, and constructs the shelf only when the head has been brought down to proper level. In his hands the shelving operation has yielded good results.

Dr. Fred H. Albee, of New York, likewise, favored the shelving operation, as it stabilizes the hip perfectly. His indication for the operation is pain.

Dr. Bade, of Hannover, recommended for older cases of congenital dislocation of the hip, particularly for the high anterior variety, the so called "*Sprengung*" (bursting of the socket) after the reduction.

Dr. Zahradníček, of Prague, demonstrated his technique for open reduction and shelving. Among sixty-five cases of all ages, eighty-three per cent. were retained; in patients from ten to thirty-two years, fifty-seven per cent.

Dr. Schanz, of Dresden, discussed his subtrochanteric osteotomy. He secures the position of the fragment by nail.

Dr. René Froelich, of Nancy, stressed the difference in the treatment of unilateral and bilateral cases. His scheme of treatment is as follows: (1) Lorenz' reduction in patients with shortening of two centimeters or less; (2) in older cases, the transposition method of Redard; (3) for the production of sufficient abduction, he uses simple orthopaedic measures, such as massage and physiotherapy; (4) in unstable cases he uses

transposition of the greater trochanter; (5) in older cases he advises arthrodesis with bone graft, shelving operation, or the osteotomy of Lorenz or Schanz.

Mathieu, of Paris, described his technique of the osteotomies, and of the osteoplastic procedures. He secured a secondary acetabulum by shelving and setting the greater trochanter downward. He also favors a combination of osteotomy with an osteoplastic method similar to Ombredanne's. There were good results in sixty-six per cent. of the cases.

Reported by A. Steindler, M.D., Iowa City, Iowa.

DEUTSCHE ORTHOPÄDISCHE GESELLSCHAFT

TWENTY-FIFTH CONGRESS HELD AT HEIDELBERG SEPTEMBER 15–17, 1930

Reported by Arthur Steindler, M.D., Iowa City, Iowa

In his opening address, the President of the Society, Prof. H. von Baeyer, of Heidelberg, discussed the aims and objects of Orthopaedic Surgery. The scope is not attained, he pointed out, until not only the function of the damaged locomotive apparatus is restored or improved to the highest possible degree from the biologic point of view; but also the restored function expresses itself in a high degree of skill or practical efficiency (*Funktion und Leistung*), which is a problem of education and training. The significance lies in the inclusion of the educational and rehabilitation phase of the work under the dominion of Orthopaedic Surgery; social rehabilitation is designated as an obligation of the orthopaedic surgeon who must have sufficient training and experience in this work to give weight and substance to his opinion and to secure his advisory influence over the work. This point of view was shared and also strongly expressed by the late Prof. Biesalski.

Prof. Ernst of Berne gave the formal oration on "Structure and Function". Starting from the studies of Hermann Meyer, he quoted the work of Culmann, Galilei, and Leonardo da Vinci. Form development as well as form persistence are represented as result of function and the word of Kant cited that our appreciation of the significance of form runs *pari passu* with our ability to find for it the mathematical interpretation.

Considering the microstructure of the cell as an expression of its function, the speaker pointed to the "*fibra*" of Glissom as the first step in the recognition of microfunction. The fiber itself has its structure, and all its parts react according to their physical qualities, to mechanical forces,—as traction, pressure, bending, conduction, etc.—in such a manner as to determine thereby the morphologic development of the structure. Prof. Ernst referred to the differentiation of cell function of the cells, the "social division of labor among the cells" of Spencer. But the modern study of microfunction goes beyond this. There is a division of function within the cells, as is apparent from the mutual relationship between nucleus and plasma, which is both qualitative and quantitative. He referred to the experiments of Petoefi, who succeeded in transplanting cell nuclei into foreign plasma in studying the nuclei as the carriers of heredity. He spoke of the enormous influence of the secretions of the ductless glands upon form development, citing the action of thyroxin, which in solution of one to five million will prevent the development of tadpoles.

In regard to the relation between body structure and higher function,—mentality, character, etc.— the speaker touched upon the question of psychic phenomena in their relation to structure, and the possibility of recording them in terms of physical phenomena, as action currents or other measurable electric manifestations. The oration was couched in masterful language and bespoke the orator's wide mastery of philosophical and natural sciences.

Herr Böhm presented a paper on "Pathogenesis of the Infantile Deformities of the

Lower Limb". The speaker considered the deformities of genu valgum, genu varum, genu recurvatum, and of pes valgus in children. He took exception to rickets, as well as the mechanical forces developed by the static functions, as being responsible for these deformities. According to his view, these deformities have definite relation to the normal development of the limb. He showed that the normal physiologic cycle is from the genu varum of the new-born, to the genu valgum of later infancy and adolescence, to the genu rectum after puberty. Likewise, there exists a physiologic pes valgus and a physiologic genu recurvatum.

This was very convincingly demonstrated on anatomical specimens of embryos. He showed on a specimen the kinking of the axis of the foot in the direction of valgity, which is the anatomic foundation of the physiologic pes valgus. He showed that the tibia of the foetus had at the upper end a recurvation and backward inclination and that the lower end of the femur, likewise, was circle-shaped instead of cardioid, in the frontal plane, so that there is no check against hyperextension, which explains the development of the genu recurvatum. Furthermore, he pointed out the difference between the head of the tibia in adult and embryo; the latter shows a downward slant of the inner condyle: the cause of the physiologic genu varum. In the adult, also, the condyles of the femur are symmetrically developed, while in the embryo the inner reaches down much lower, corresponding to the obliquity of the inner condyle of the tibia. Overcompensation easily leads to accentuation of the genu varum.

X-ray pictures were shown, confirming the author's views, the genu valgum of women on the basis of the above named asymmetry of the lower end of the femur with symmetry of the condyles of the tibia (undercompensation). In the same sense the genu varum was shown to be formed by overcompensation, slant of inner condyle of tibia, and downward projection of the inner condyle of the femur. In genu recurvatum the wedge-shape of the upper tibial epiphysis can be demonstrated in the side view, and in the pes valgus the wedge-shape of the lower tibial epiphysis in the front view. While the speaker confined himself in his argument to the demonstration of the embryonic preformations, which lead to these deformities, and which present the latter in the light of developmental arrest or inhibitions, the question of the deeper underlying causes, such as hereditary constitution and internal secretion, was touched upon. He furnished an interesting sidelight to the question of atavism and reversal of type by the demonstration of specimens of the lower limbs of apes, which showed formations analogous to the described embryonic forms in man persisting into their later life and leading to corresponding deformations.

Dr. Murk Jansen, of Leiden, discussed the wrinkling and folding of the foetal axis in its relation to congenital malformations. The mechanical factor is the pressure of the amnion, which does not become adherent to the chorion until the end of the fourth month, upon different portions of the embryo and in different positions of the latter. In the second and third week, the wrinkling of the foetus, under pathologic amniotic pressure, leads to anencephaly, amyelia, or rachischisis. The curling of the axis in the third and fourth week leads to synotism, or cyclopia, while in the fifth and sixth week achondroplasia results from direct membrane pressure with backward displacement of the hard palate and dorsal kyphosis. The amniotic tension produces severe circulatory disturbances by way of stasis and dysplasia of the blood vessels, especially after fusion of amnion and chorion. The same principle applies for the seventh foetal week, when mongolism and idiocy develop and the head is forced against the chest by amniotic pressure, and for the eighth, the time for the dysostosis cleidocranialis, when the shoulder is forced forward by amniotic pressure. Only in osteogenesis imperfecta, the origin of which Jansen dates at the ninth week, is there hyperextension of the head and the lower eyelid protrudes more forward than the upper. To this period also belongs the formation of the flat acetabulum and heavy, thickened floor, where by amniotic pressure deformations of the head and subluxations, and by side pressure upon the tuberosity ischium a varum is produced. Still later, the amniotic pressure exerts its influence upon the formation of the congenital club-foot and the congenital hip dislocation.

Dr. Farkas, of Budapest, discussed the pathogenesis of hip joint contractures. He considered first the physiologic flexion contracture of the hip which responds to traction by subluxation of the joint; contracture conditioned by bone and joint preformation. On the other hand, a long persisting contracture leads to secondary changes in the position of the articular bodies, so that a distinction between primary and secondary contractures can be made.

Herr Kallius presented a classification table of the congenital deformities, divided into two main groups,—the non-hereditary and the herditary or endogenous, congenital deformities. The former he again divided into those from physical causes (scoliosis, etc.) and biochemical causes (spina bifida, platyspondylia, morphologic variations); the hereditary he divided into the regressive and progressive forms. To the latter belongs the synostosis cervicalis of Klippel Feil, which was more extensively discussed by the speaker. X-rays were also shown of this deformity as well as of remarkable cases of occipitalization, of cervical wedge and supernumerary vertebrae, and of cervical ribs.

Second day: September 16, 1930.

I. The Pathology of the Upper Extremity.

Prof. H. Spitzy, of Vienna, gave a very thorough and lucid résumé on the present views and experiences of many of the more important pathologic conditions. Of the congenital deformities he discussed the extromelias and phocomelias of the arm, the congenital synostosis, and mentioned the congenital dislocation of the shoulder and of the head of the radius. Furthermore, malformation by suppression or excess, such as syndactylism, oligodactylia, and polydactylism were considered and many practical instructions were given in regard to the operative treatment. The speaker discussed more at length the congenital elevation of the scapula and the obstetrical paralysis; in the latter emphasizing the neurogenetic character and the necessity of neurolysis in case of failure of the conservative treatment. Interesting cases of club-hand deformity were shown in slides. Of the traumatic conditions, the speaker gave special attention to the ischaemic contractures, advising the removal of the carpal bones for the extreme forms of flexion contracture. Spitzy also succeeded in covering the essential points of treatment in a number of other pathological conditions of the upper extremity, in a short and clear-cut manner.

Dr. Steindler, of Iowa City, U. S. A., spoke on the poliomyelitic upper extremity. The essayist confined his topic to the paralyses of the upper extremities following anterior poliomyelitis. He considered the normal dynamics of the upper extremity musculature and developed from it the mechanical pathogenesis of the more common forms of contracture and disequilibrium of the arm and hand seen in poliomyelitis. He further discussed the types of distribution of the paralysis and the effect of shoulder paralysis upon the equilibrium of the spine. Indications and technique of the conservative treatment were given. Splints and apparatus were demonstrated in slides. The indications and the technique of the operative treatment were next considered, and the details of the principal operations were likewise illustrated. Reports were made on the late results of 139 operations, among which were: arthrodesis of the shoulder, sixty-three cases; the author's flexor plasty of the elbow, forty cases; flexor plasty of the thumb, twenty cases; and others. Reconstruction results and working ability developed after operations were further illustrated in the motion picture.

Herr Vischer, of Vienna, Herr Gorcke of Dresden, and Herr Kölliker of Leipzig, presented papers dealing with the subject of prosthesis, and emphasized the tendency toward simple construction, the practical rather than the cosmetic appliance for the arm, and the frequent rise in the social scale due to training.

Herr Mau, of Kiel, reported the case of a patient with loss of all extensor tendons of the wrist and fingers after injury.

Herr Max Lange, of Munich, discussed myogeloses or muscle indurations in the shoulder region.

Dr. Špišič, of Zagreb, spoke of the treatment of ischaemic contractures.

Herr Pitzen, of Munich, advised for the deltoid paralysis a transposition of the outer third of the muscle in cases where this portion has escaped paralysis.

Herr Brinkmann, of Hamburg, considered the treatment of shoulder-joint contractures with physiotherapy and splints.

Herr Dittmar, of Heidelberg, gave a presentation of the shoulder-blade movements from the dynamic point of view.

Herr Valentin, of Hannover, spoke on congenital dislocation of the humerus.

Herr Schliepe, of Berlin-Dahlem, reported on the Krukenberg operation for the cinematization of forearm stumps.

Herr Legal, of Heidelberg, spoke on the operative treatment of the habitual dislocation of the shoulder.

Herr Mosenthat, of Berlin, reported eleven cases of habitual dislocation of the shoulder.

Dr. Silfverskiöld, of Stockholm, explained his treatment of this condition.

Herr Schneck, of Vienna, discussed the treatment of carpal injuries.

Dr. Steinmann, of Berne, quoted statistics on the condition of habitual shoulder dislocation.

Herr Alsberg, of Kassel, uses the method of fastening the long biceps tendon to the coracoid.

Herr Wittek, of Graz, has had no recurrences with his method in fifteen cases.

Herr Löffler, of Halle, has used his method since 1919, and has observed only one or two recurrences.

Herr Frosch, of Arnstadt, discussed the arthritis deformans which frequently follows fracture of the scaphoid.

Herr Dittrich, of Heidelberg, referred to the ulnar abduction so frequently seen in either poliomyelitic or arthritic contractures.

II. Bone and Joint Tuberculosis and Orthopaedic Surgery.

Herr Ludloff, of Frankfurt a.M., discussed the pathogenesis, types, frequency, and surgical distribution of tuberculosis. He pointed out the characteristic features, clinical as well as pathologic, of the caseous and proliferative forms. The x-ray diagnosis and the prognostic value of serial x-ray pictures were amply illustrated. The laboratory diagnosis, tuberculin, guinea-pig reactions, sedimentation time, and the blood picture were duly considered. He analyzed the usual immediate causes of death,—meningitis, miliary tuberculosis, amyloid degeneration, and pulmonary tuberculosis—in their relation to the type of osseous tuberculosis. Regarding the therapy, the general hygienic, the open air treatment, heliotherapy, and dietary treatment (Gerson, Sauerbruck, and Hermannsdorfer diets) were strongly emphasized. Recumbency and plaster immobilization are the principal phases of the local treatment. On the operative side, he mentioned osteotomies, etc., for correction of deformity, costotransversectomy for intrathoracic abscesses, the Albee operation as a palliative method, and the arterial sympathectomy of Leriche for active hyperaemia. He also mentioned occupational therapy as part of the routine treatment.

Herr Max Lange, of Munich, reported his experiences with the conservative ambulatory treatment, the average duration being three to four years of orthopaedic treatment, which is economically possible only in ambulatory patients. Of 312 patients, seventy-six per cent. were cured or improved, thirteen per cent. were worse and eleven per cent. died. These figures were based upon protracted observations of from five to ten years' duration. Recurrences were noted in three per cent.; good mobility of the joints was obtained in fifteen per cent., ankylosis in forty-eight per cent., and flail joints in thirty-seven per cent. He believes that the ambulatory treatment produces as good results in surgical tuberculosis as the sanatorium treatment.

Herr Simon, of Berlin, reported on the extension treatment of hip and knee, quoting excellent results. He recommends traction treatment, especially for tuberculosis of the foot and ankle.

Herr Driels, of Frankfurt a.M., Herr Brandes of Dortmund, Herr Alsberg of Kassel, and Herr Fliegel of Vienna spoke of their experiences with the spleen treatment.

Brief papers were presented by Herr Hauer and Herr Nitsche of Berlin, Herr Gaugele of Zwickau, Herr Wollenberg of Berlin, Herr Kiewe of Königsberg, Dr. Hackenbroch of Cologne, and Herr Kochs of Suechteln, who spoke of their experiences in the treatment of tuberculosis.

III. The Principles of the Mechanical Treatment in Orthopaedic Surgery.

Herr Schede, of Leipzig, spoke on the technique of recumbency and position. He explained the mechanical prerequisites of thorough immobilization,—for instance, to immobilize the hip joint a double hip spica is necessary. He showed, on a temperature chart, that thorough immobilization often controls the temperature in surgical tuberculosis. He demonstrated the placing of the patient with hip spica in bed, the three-piece mattress, the technique of placing the patient in prone position, the provisions for the patient to lift himself—the overhead structures with trapeze, or rail and carriage.

This subject was continued by Herr Sudbrack, of Leipzig, who spoke on pulley and weight extension.

Herr Schrader, of Heidelberg, began his discussion of the topic by reference to the mechanical principle underlying the orthopaedic treatment, and applied the general laws of mechanics to the plaster-of-Paris and apparatus technique. Speaking of the latter, he divided them into rigid supportive apparatus and hinged apparatus with directed motion of the parts. The corrective effect in either the rigid or hinged brace is of the pressure or traction type, or combinations thereof.

Herr Bettmann, of Leipzig, showed some practical technical details,—the rail and carriage for suspending the patient during walking drill; the kiddie-car tricycle, for mobilization exercises in patients with congenital dislocation of the hip, etc., during and after cast treatment; the under-water exercises in paralysis.

Herr Möhring, of Kassel, speaking of exercise therapy by apparatus, showed a number of constructions of the Krukenberg and Zander pendulum type, for shoulder, hip, knee, elbow, etc.

Herr Mommsen, of Berlin-Dahlem, demonstrated a fundamental principle of body dynamics,—namely, the unity of the locomotive apparatus owing to which movements of the parts are transmitted according to definite mechanical laws to the entire mechanical system of the body. This interrelationship, in the mechanical sense, between all body parts can be given graphic expression by the use of Biesalski's tridimensional measuring apparatus. This marks the position of a number of landmarks of the body and projects them in all three planes; the points to be marked are adjustable markers, which are fastened to a double pipe frame all around the body, and the frame is so arranged that after the marking rods are set, one side of the frame may be lifted off and the patient may step out. The markings are transmitted by a drawing device to three planes, so that a front, a side, and a cross elevation are obtained on paper. In this way the relative changes of all body landmarks during any motion of the body are visualized. The speaker showed the relation of the body parts in malposture, kyphosis, scoliosis, etc.

Herr Erlacher, of Graz, discussed the pathogenesis of scoliosis, referring to Heuer's theory of the asymmetric growth of the bodies. Erlacher attributed to the intervertebral discs an important rôle in the development of scoliosis (see also Schulthess). The discs, when waterlogged, increase considerably in height. Erlacher made some experiments in which he soaked the discs and then fixed the spine in some fixing fluid. He demonstrated an enormous increase in the height of the discs. These also show daily fluctuations in height, according to their fluid content. Another factor in the pathogenesis of scoliosis is the nucleus pulposus, which assumes the function of a semi-joint about which the inclinatory, as well as the rotatory movement from vertebral body to vertebral body takes place, and which has a great deal to do with the development of scoliosis. Erlacher further speaks of the anterior longitudinal traction system of the thorax,—namely sternum and anterior thoracic muscular apparatus—which may

influence the formation of anteroposterior (symmetrical) or lateral (asymmetrical) spinal deviations.

Herr Klar, of Munich, discussed spondylolisthesis and prespondylolisthesis, following in general the accepted views on the congenital preformation and pseudarthrosis formation in true spondylolisthesis. Without these, a true spondylolisthesis cannot occur. Sacralization of the lumbar spine represents a futuristic type of anomaly, the spine, in its phylogenetic development, fortifying itself thereby more and more for its orthograde weight-bearing function. He showed very interesting x-rays and anatomic specimens touching on the subject.

The discussion of this subject was continued by Herr Block of Witten, and Herr Goecke of Dresden.

Herr Gaugele, of Zwickau, speaking of osteochondritis coxae juvenalis (Legg-Calvé-Perthes' disease) demonstrated the analogous changes in the acetabulum, the so called Perthes' socket, which consist in a zone of decalcification, fragmentation, cysts, obliquity of the outer portion of the acetabulum, and subluxation. Anabolic and catabolic processes run concurrently. He referred to the theory of Calot, agreeing with him that a double socket (*double fond*) exists, though differing from him in its interpretation.

Herr Walter, of Münster, discussed Deutschländer's, Köhler-Freiberg's disease, and related conditions. He demonstrated in the x-ray the fragmentation of the calcaneus apophysis; he showed cases of Deutschländer's disease with spindle-shaped enlargement of the metatarsals and pseudarthrosis; he demonstrated cases of Köhler-Freiberg's disease of the heads of the metatarsals with wedge-shaped sequestra in the heads, as in osteochondritis dissecans of the knee; and, finally, cases of malacia of the lunatum (Kienböck's disease). He advanced the infection theory for the pathogenesis of these conditions.

Dr. Farkas, of Budapest, discussed the problem of stabilizing the pelvis in cases of irreducible congenital dislocation of the hip. He considered first the different methods of osteotomy, the Schanz method of securing the fragments by nails, the Baeyer-Lorenz method, and others. The lower the osteotomy, the better is the mechanical result. He has modified the technique by drilling holes through both fragments after the osteotomy, running a strong thread through them, and passing the thread out through the wound. In this way he can control the position of the fragments. Five cases operated upon in this manner gave good results and showed quick callus formation.

Dr. Springer, of Prague, uses for the securing of the fragments a strip of fascia lata.

Herr Mau, of Kiel, spoke on osteopathy of the patella. In the picture the mottling, atrophy, fragmentation, irregular outlines, especially at the poles, exostosis, and new bone formation to complete transformation are illustrated. Pathogenetically he classifies the condition with the malacic processes with aseptic necrosis, similar to that produced by Wollenberg's experiments of tie-suturing the blood supply of the bone.

Herr Simon, of Berlin, discussed a case of generalized osteitis fibrosa.

Dr. Kuh, of Prague, also discussed a case of osteitis fibrosa.

Herr Valentin, of Hannover, reported two cases of osteitis fibrosa with extreme coxa vara and spontaneous fracture.

Dr. Michaelis, of Breslau, demonstrated an entirely new method of microscopic examination of the macerated bone in the reflected light.

Herr Gaugele, of Zwickau, demonstrated the treatment of tuberculosis of the hip on the inclined board and with active motion-therapy.

Herr Eckhart, of Berlin-Dahlem, showed the technique of popular instruction used at the Oscar-Helene-Heim. Progress in cripple care was also shown.

Herr Möhring, of Kassel, demonstrated a new osteoclast and a recording device for flat-foot; also, a bandage for splay-foot.

Herr Haberler, of Vienna, showed apparatus for active and passive correction, etc.

Herr zur Verth, of Hamburg, demonstrated two types of patella bipartita.

Herr Herbst, of Charlottenburg, demonstrated his Omega splint to immobilize the head after operation for wry neck.

Current Literature

DIE KNOCHENBRUCHBEHANDLUNG MIT DRAHTZÜGEN (The Treatment of Fractures with Wire Traction). By Prof. Rudolph Klapp and Dr. Werner Block, Vienna, Urban and Schwarzenberg, 1930.

Prof. Klapp and Dr. Block have not attempted another textbook on fractures or a critical review of statistics. Skeletal traction is now a well established adjunct to surgery. The writers have supplied a carefully illustrated monograph on the various aspects of its application to fracture work and other branches of orthopaedic surgery. Their opinions are of particular value because they have been in close touch with the originators of some of the apparatus, and are responsible for many improvements.

After a brief review of the history of fracture treatment in general and the development of skeletal traction in particular, one is introduced to various forms of traction apparatus now in use in Europe. Most of the emphasis is laid on the use of wire pulls in either the longitudinal or lateral direction. Combinations of pulls and the use of "distraction" apparatus become very complicated in some instances. The Kirschner outfit is given first rank for simplicity and adaptability.

The advantages of wire over nail or clamp become readily evident. The general disadvantages of technical difficulty and risk of infection are seen to be negligible when the treatment is in the hands of a specially trained surgeon with a large fracture experience.

A detailed discussion of the various techniques is followed by illustrations of their application in individual fractures. Various other uses for wire extension in orthopaedic surgery are suggested.

The book contains much that is new. It should be read with interest by anyone who is occupied with the special problems of bone work.

OSTÉOSYNTHÈSE. By Dupuy de Frenelle. Paris, N. Maloine, 1931.

The first part of this work takes up in detail the general principles in the surgical treatment of fractures, giving in axiomatic clearness the most essential rules or principles which should govern this treatment. The author states in the beginning that the success of surgical treatment of fractures is a question of instrumentation, asepsis, and judgment. The instruments which are of use in treating these conditions, and the various means of retention, and the manner of their use are described and their application is illustrated, all of which is of particular value to all those who have not had a large experience in this department of surgery.

The two other portions are devoted, respectively, to description of fractures of the upper and of the lower extremity, with the application of the general and special principles laid down in the first portion of the book. All of the usual and many of the unusual fractures are described in detail, and the various steps in the operative procedures, which are also generously illustrated. In the portion of the book devoted to the lower extremity, the chapters on fractures of the femoral neck will be found interesting as well as suggestive, and with some unusual and somewhat striking surgical procedures, some of which should not be attempted except by thoroughly trained surgeons experienced in this special branch of surgery. This book deals with the surgical treatment only, no attempt being made to consider the diagnosis or the non-operative measures; and is by a surgeon who has had a large experience and whose tendencies are distinctly operative. This should be remembered by those readers who have not had this special training.

An excellent foreword and analysis, taking up each chapter in turn, is given by Lambotte, who has greatly influenced the author in his work. Incorporated as a part of the book, this is of particular value, as he does not always agree with the author, and discusses each subject with a distinct frankness.

DIE EPIDEMISCHE KINDERLÄHMUNG (Epidemic Infantile Paralysis). By Geheimrat Hofrat Prof. Dr. Fritz Lange. Munich, J. F. Lehmann, 1930.

No one can read this monograph without being impressed by the earnestness of the author. This book, one feels, represents Lange's life-work; it is his "*religio medici*". Although a similar volume had been begun long before the War, the manuscript had lain dormant for many years, and it was not until 1927, when Lange came perilously near death during an attack of appendicitis, that the recital of his experiences in the treatment of infantile paralysis became a compelling thought.

For the next two years, during the early morning hours from 4:30 to 6:30, when his colleagues, German as well as American, were sound asleep in their beds, Lange wrote this monograph, thus earning beyond the shadow of a doubt a preeminent place in Osler's "early lark" type. His achievement is all the more remarkable when one remembers his sixty-seven years and the pressure imposed by his official duties as university professor and head of one of the largest clinics in Germany.

The first chapter deals with the history of poliomyelitis, its pathology, etiology, transmission, and experimental reproduction; the second with the clinical picture during the acute stage; the third with its general treatment. In all three Lange draws freely from the American literature, particularly from MacAusland's book on infantile paralysis. He stresses the fact that American scientists have done preeminent work in the investigation of poliomyelitis and that this portion of his book has been written largely with the purpose of diffusing a knowledge of their researches among German physicians. The next two chapters (pp. 61–pp. 305) are a detailed account, first of the general treatment of paralytic deformities, second of the special treatment applied to each type of deformity. Paralytic equinus calcaneus, varus, valgus, and dangle-foot, paralysis of the knee extensors and flexors, of the extensors and abductors of the hip, of the abdomen and back muscles, of the deltoid, flexors and extensors of the elbow, the wrist and fingers, are each considered in turn. Lange's peculiar contribution is the development of Gluck's silk tendon implantation into a well coordinated system of operations designed to correct paralytic deformities. This system represents a gradual evolution based upon thirty-five years of clinical and experimental data. One of the most important features of Lange's work is his frank recognition of his errors. He does not hesitate to present photographs of patients to illustrate these mistakes so that others may avoid the pitfalls into which he has fallen. To offset the failures, are pictured results so successful as to excite the incredulity of those who are not aware of Lange's accuracy and honesty.

A strand of silk when implanted to replace a paralyzed tendon does not remain an inert foreign body, but is rapidly surrounded by a tube of connective tissue which, in time, may become as thick as a finger and assume microscopically many of the characteristics of tendon tissue. The silk itself then merely acts as a core, the main work being done by the enveloping pseudotendon. Thanks to the development of this pseudotendon, Lange is able to utilize the contraction of distant muscles to replace paralyzed. The most striking instance is the conversion of the latissimus dorsi into an abductor of the opposite hip. Other examples are the utilization of the pectoralis major as a flexor of the elbow, of the teres major and latissimus dorsi as extensors of the elbow, of the erector spinae as a substitute for the gluteal muscles.

To us in America and England, accustomed to rely upon stabilizing bone procedures coupled with tendon transplants, Lange's method when applied to the foot must seem so radically different as to arouse many a doubt. To correct a drop-foot, Lange does not execute a Campbell bone block, but runs two silk tendons from the active gastrocnemius down to the foot, one on the outer side to the cuboid, the other on the inner side to the

internal cuneiform. When dealing with a club-foot, due to paralysis of the evertors, in the presence of a strong tibialis anticus, he does not transplant the tibialis anticus to the outer border of the foot nor execute a Hoke operation, but after a preliminary redressment, he simply attaches his silk strands to the tibialis anticus a few inches above the ankle and runs them down to the cuboid. As the muscle contracts, an inversion of the foot is prevented by the strong cord passing to the outer border of the foot. Strange though the procedure may seem to us, excellent results are shown many years after the operation.

The book is written in a terse vigorous style. In its simplicity, it is frequently eloquent. Throughout one realizes the high purpose of its author, his tenacity, and his originality. Whether his method, demanding as it does not only meticulous attention to every detail but the enthusiasm born of conviction, will ever be accepted as generally in this country as the methods now current seems to me doubtful. Yet no one can study this volume without being stimulated by its wealth of new ideas and its splendid grasp of the essentials of orthopaedic treatment. Crystallizing as it does the unique experience of a master orthopaedic surgeon, it stands as a noteworthy contribution to one of the most important orthopaedic problems,—the treatment of paralytic deformities.—*Leo Mayer, M.D., New York, N. Y.*

THE PHYSICIAN THROUGHOUT THE AGES. By Arthur Selwyn-Brown, B.Sc., M.A., Ph.D., LL.D., Assisted by Distinguished Medical Specialists. 2 Vols. New York, Capehart-Brown Co., Inc. (Obtainable from the Springfield Printing and Binding Company, 279 Dwight St., Springfield, Mass.). $7.50 per set.

One is impressed with the scope of this work, and with the completeness with which the plan has been followed out, for the history of the development of medicine has been thoroughly treated from the earliest and most primitive times to the present. In this way, the influences which have played their part in this gradual but most stupendous growth are seen, and the relation of the status of this art of medicine to the stage of general development of civilization is followed in the various ages.

The early methods and means of therapy are described,—the art of medicine as shown in the crude attempts of primitive peoples of different races and in various countries. This of itself makes delightful reading, and furnishes a foundation for the structure of the book which follows. The development of the practice of medicine from the time it actually became an art, emerging from the practice of superstition, etc., is then shown, bringing into clear relief the various factors which have worked together to build up to the present time, as well as the men who have been influential along the way and who have given their urge to this great undertaking.

The first portion of Volume I discusses the history of American medicine, its growth and development, and illustrates this by a description of the progress in many of the individual states.

Volume II considers the history of medicine from the end of the period of the Revolution to the present time in every possible phase. In this portion of the work, the parts played by the more general forces,—such as surgery and medicine, each in its own department—the literature, medical societies, etc., are given, with their origin and growth, and especially their influence on medicine as an art. With the more accurate means of investigation and research, the subdivisions automatically appear, and the rise of specialism results. Later the subdivision of medicine is considered, as well as the history and the method of this unfolding, and this portion of the subject occupies the larger part of the various chapters of this second volume.

The work comprises two volumes of 1700 pages, and is generously illustrated with photographs of old interesting pictures, which show the conception of medicine in the various ages; there are also excellent photographs of those men who have played prominent rôles along the way. The scope of the work is too comprehensive to admit of detailed description, but it is a most readable book, and with a fund of encyclopaedic knowledge.

MEDICAL AND SURGICAL REPORTS OF THE EPISCOPAL HOSPITAL (Volume VI). Philadelphia, Wm. J. Dornan, 1930.

This volume contains several articles of interest in orthopaedic or traumatic surgery. This list includes articles on:

The Treatment of Arthritis with Salts of O-Iodoxy-Benzoic Acid. By James E. Cottrell, M.D.

Fractures 1853 and Now. By Edward T. Crossan, M.D.

Orthopedic Surgery in the Last Seventy-five Years. By Rutherford L. John, M.D.

Stoffel's Operation for Spastic Paralysis, With Report of Thirty-two Cases. By A. Bruce Gill, M.D.

Infectious Osteomyelitis: Differential Diagnosis. By Ralph S. Bromer, M.D.

Multiple Giant-cell Tumors: Report of a Case and Review of the Literature. By Emory G. Alexander, M.D., and William H. Crawford, M.D.

With the exception of the articles by Dr. Crossan and Dr. John, these articles have been published and are reprinted in this volume. Their inclusion in this form makes them particularly available to the general, the orthopaedic, and the industrial surgeon.

The Journal wishes to acknowledge the receipt of the following publications sent to the Editorial Department:

*Immuno-Chirurgie. La Sérothérapie et la Vaccinothérapie en Chirurgie. By Gaston Daniel. Paris, Norbert Maloine, 1931.

*Chronic Arthritis and Rheumatoid Affections with Recovery Record. By Bernard Langdon Wyatt, M.D., F.A.C.P. New York, William Wood and Company, 1930.

*Hefte zur Unfallheilkunde (Beihefte zur "Monatsschrift für Unfallheilkunde und Versicherungsmedizin"). "Lumbago und Lumbago Ossea unter besonderer Berücksichtigung der Unfallentstehung", von Prof. Dr. M. zur Verth. Leipzig, Heft 5, 1930.

Ortopedia e Traumatologia dell'Apparato Motore. Naples, Vol. II, No. 5, October 1930.

Bulletin of the National Tuberculosis Association. New York, Vol. XVI, 1930.

Slovanský Sborník Ortopedický. Brno, Czecho-Slovakia, Vol. V, No. 4, 1930.

The Rockefeller Foundation, Annual Report. New York, 1929.

Norsk Magasin for Laegevidenskapen. Oslo, Vol. XCI, Nos. 10, 11, 12, October, November, and December 1930.

Bullettino e Atti della Reale Accademia Medica di Roma. Rome, Vol. LVI, Nos. 8, 9, August and September 1930.

Giornale Medico dell'Ospedale Civile di Venezia. Venice, Vol. IV, Nos. 3, 4, June and August 1930.

Medicina del Trabajo e Higiene Industrial. Madrid, Vol. I, No. 5, July 1930.

University of Pennsylvania Bulletin, Graduate School of Medicine, The Medico-Chirurgical College. Announcement for Twelfth and Thirteenth Annual Sessions. Philadelphia, 1930.

The University of Chicago Announcements, The Medical Schools, 1930-1931. Chicago, The University of Chicago Press, 1930.

The Cancer Program of Massachusetts. By George H. Bigelow, M.D. Washington, The Committee on the Costs of Medical Care, 1930.

*To be reviewed in a later issue of *The Journal*.

Volume LXVII of *Acta Chirurgica Scandinavica* was published as a memorial to Prof. Patrik Haglund on his sixtieth birthday. His picture is the frontispiece. There are nine hundred seventy-eight pages comprising sixty varied orthopaedic articles by outstanding men of fourteen countries. The titles of all and abstracts of some of the articles are given.

ASPLUND, GUSTAF: A Few Cases of Ischiopubic Osteochondritis. Page 1.

Symptoms of pain in the hip or groin, after exertion; abnormal fatigue of one lower extremity; a slight limp; limitation of hip motions; oedema of the perineum, and tenderness over the ischiopubic ossification center in a child of six to twelve years should sug-

gest the possibility of an ischiopubic osteochondritis. If this unusual condition is present, an x-ray will show a rarefied, granular enlargement of the point of contact of the two bones. The disease is allied to the other osteochondritides. It usually subsides promptly with rest, but a secondary infection may require incision and drainage. Staphylococci were isolated from some cultures. Five cases from the literature and two new ones are cited.

VAN ASSEN, J.: Angeborene Kyphose (Congenital Kyphosis). Page 14.

BADE, PETER: Hippokrates und die angeborene Hüftverrenkung (Hippocrates and Congenital Dislocation of the Hip). Page 34.

VON BAEYER, H.: Der Arm als Werkzeug (The Arm as a Tool). Page 43.

The various functions of the hand and arm furnish material for an unusual essay.

BENTZON, P. G. K.: Ein Fall von Morbus Haglundii calcanei mit monströsen röntgenologischen Änderungen (A Case of Haglund's Disease of the Calcaneus with Marked Roentgenologic Changes). Page 48.

The name of Haglund, the first to describe the condition, is suggested to designate the epiphysitis of the calcaneus analogous to that of the tibial tuberosity of Osgood-Schlatter. The clinical and x-ray study of one case is reported. From the injection of the heels of three amputated specimens, and the study of x-rays, the writer inclines to the theory of disturbed arterial supply as an etiological factor.

BERNTSEN, AAGE: Drie Fälle von Manus vara congenita ohne Defect der Vorderarmknochen (Three Cases of Manus Vara Congenita Without Defect of the Bones of the Forearm). Page 61.

BIESALSKI, KONRAD: Der Einfluss der Krüppelfürsorge auf die Orthopädie (The Influence of the Krüppelfürsorge [Federal Cripple Care] on Orthopaedics). Page 68.

The organizer of the Krüppelfürsorge in Germany gives a résumé of the history of the movement.

BLENCKE, AUGUST: Die Lunatumnekrose der Hand und ihre Beziehungen zum Unfall (Necrosis of the Carpal Semilunar and Its Relation to Injury). Page 91.

Forty-three cases of malacia of the carpal semilunar are reviewed statistically with special reference to etiology. Only four were in females. In twenty-six, trauma played no part; in five a slight injury had preceded the onset; and in twelve a severe trauma was the probable cause. The types may be classified as spontaneous, professional, and traumatic. The history of trauma must be carefully evaluated. A fracture may be primary, or secondary to malacia of the bone. The disease is typically a rarefying osteitis due to tearing of the ligaments and impairment of nutrition. It differs from Köhler's disease in its predilection for older age groups. Prof. Blencke is opposed to extirpation on the ground that removal of the bone does not prevent the occurrence of arthritis. With treatment by rest and later a leather cuff, some complete recoveries were obtained.

VON BOGNÁR, JOHANN: Die tuberkulösen Knochencysten (Tuberculous Bone Cysts). Page 135.

BROLIN, JOHN: Ein neuer Extensionsbehandlungsapparat bei Spondylitis cervicalis tbc. (A New Apparatus for Applying Extension in Tuberculosis of the Cervical Spine). Page 143.

BÜLOW-HANSEN, V.: Über die Behandlung, inbesondre Nachbehandlung von Luxatio coxae congenita (The Treatment, Particularly the After-care of Luxatio Coxae Congenita). Page 147.

BÖHLER, LORENZ: Verrenkungen der Handgelenke (Dislocations of the Wrist). Page 154.

BÖHM, MAX: Physiologische Deformitäten des Beins (Physiological Deformities of the Lower Extremity). Page 178.

In their physiological development the bones of the lower extremity change in form and relative position. Their characteristics are early similar to those of the primate skeleton, and greatly different from the adult human. Foetal "contractures" cannot be fully explained on the basis of pressure or muscle pull. Philogenetic anatomy establishes the reason for the occurrence in the foetus, baby, and child of pes calcaneus, varus, and valgus, and genu recurvatum, varum, and valgum. These physiological "deformi-

ties" are largely the result of primary changes of the bones, and particularly of the epiphyses.

CALOT, F. Sur le meilleur Traitement local des Tuberculoses des Os, Articulations et Ganglions lymphatiques. D' après 38 Ans de Pratique (The Most Desirable Treatment of Tuberculosis of Bones, Joints, and Lymph Glands. Thirty Eight Years' Experience). Page 206.

After a three years' trial, resection and other open operations for tuberculosis of bones, joints, and lymphatics were abandoned in spite of their forty years of popularity. Foci of surgical tuberculosis cannot be completely eradicated by operation because of the extensive lymphatic involvement. Operations usually lead to the formation of objectionable fistulae. Orthopaedic operations are permissible when the foci have been cleared up. Aspiration and injection is the method of choice for local treatment, but must be carried out exactly as outlined by Calot.

CAMITZ, H.: Die Stabilisierung des Fusses nach Kinderlähmung (The Stabilization of the Foot Following Infantile Paralysis). Page 227.

The literature is exhaustively reviewed. Operations are classified according to deformity and technique and one hundred and sixteen case reports are tabulated in detail.

The paralytic foot cannot be adequately stabilized by tendon transplantation. Pronation and supination must be sacrificed by subastragalar arthrodesis and the remaining muscle power applied to motion in the sagittal plane. When the calf muscles are paralyzed, astragalectomy gives excellent results. In selected cases with extensive paralysis, temporary removal of the talus (pan arthrodesis) is to be preferred.

DEUTSCHLÄNDER, CARL: Grundsätzliches zur Radikaloperation der veralteten angeborenen Hüftverrenkung (The Principles of Radical Operation for Old Congenital Dislocations of the Hip). Page 292.

Contracted pelvifemoral muscles constitute as important an obstacle to reduction of old congenital dislocations of the hip as the local changes in the joint. Traction is insufficient to overcome these contractures. A preliminary operation to tenotomize or elongate all of these muscles should be followed by ten to fourteen days of skeletal traction before the hip is reduced by open operation. In the second operation the importance of good exposure, wide dissection, and the avoidance of any force is emphasized.

DUVERNAY, L.: Qu' est-ce que le Morbus coxae senilis? (What Is Morbus Coxae Senilis)? Page 308.

EDBERG, EINAR: Some Experiences of Filling Osseous Cavities with Plaster. Page 313.

VAN EDEN, P. H.: Behandlungserfolge der Oberschenkelschaftbrüche (Results in the Treatment of Fractures of the Shaft of the Femur). Page 320.

A review of eight hundred and ninety-seven cases of simple fracture of the shaft of the femur showed that the results in medium-sized or small hospitals where the attending surgeon personally supervised the entire treatment were better than those in the large hospitals. The best results are obtained in the special accident hospitals. In reducing the period of invalidity, the method of treatment is of less importance than the care with which it is carried out.

ELOWSON, S.: Ein Fall mit "Klippel-Feils Syndrom" (A case with "Klippel-Feil's Syndrome"). Page 326.

In a child with great shortening of the neck, rotation and forward inclination of the head, and elevation of the right shoulder; the demonstration of bony bridges between the upper dorsal and lower cervical spinous processes with impingement on the skull, substantiated the diagnosis of Klippel-Feil's syndrome. The treatment is less important than the differentiation from tuberculosis.

FALTIN, R.: Über Pappschienen (The Use of Cardboard Splints). Page 332.

FOERSTER, O.: Beitrag zum Werte fixierender orthopädischer Operationen bei Nervenkrankheiten (The Value of Immobilizing Orthopaedic Operations in Nerve Lesions). Page 351.

FRISING, G.: Nachuntersuchung der an der orthopädischen Universitätsklinik in Lund der Totalexstirpation unterzogenen Fälle von Meniskusschäden im Kniegelenk (A Follow-up Examination of the Cases of Semilunar Cartilage Injury Which Came to Operative Removal at the University Orthopaedic Clinic of Lund). Page 377.

FROSTELL, GUNNAR: Über sagittale Kurvaturen der Wirbelsäule vom morphologischen Gesichtspunkt (Sagittal Curvatures of the Spine from a Morphological Point of View). Page 403.

GANUGELE, KARL: Muskelatrophie bie orthopädischen Erkrankungen und infolge orthopädischer Behandlung (Muscle Atrophy in Orthopaedic Diseases and Resulting from Orthopaedic Treatment). Page 421.

Atrophy is classified as primary, resulting from disease, and secondary, due to disuse. The latter type is often attributed to orthopaedic appliances. To the contrary, casts and splints which decrease deformity and thereby increase function, diminish the atrophy. This is as true of the back in scoliosis after the application of the proper corset, as it is in the leg after the use of a walking cast.

GUILDAL, POUL: A Modification of the Prosthesis in Exarticulatio Coxae. Page 442.

HACKENBROCH: Das atypische Genu varum (Atypical Genu Varum). Page 448.

HANSON, ROBERT: Ein Fall von Vertebra plana, der verschiedene Entwicklungsphasen dieses Leidens beleuchtet (A Case of Vertebra Plana Illustrating the Various Phases of Development of this Disease). Page 461.

JOHANSSON, SVEN: Ein operierter Fall von Spaltbruch des Schienbeinkopfes (An Operated Case of Longitudinal Fracture of the Tibial Head). Page 476.

Conservative measures failed to reduce a longitudinal fracture of the outer tibial condyle. At operation the lateral semilunar cartilage was found to be caught in the fracture line. Removal of the cartilage and spiking of the fragment gave an excellent result.

KAHLMETER, GUNNAR: Rheumatic Disease as a Medical Specialty and its Relation to Orthopaedics. Page 482.

KEY, EINAR and STROMBERG, NILS: Über Operationen wegen Meniskusschäden im Kniegelenk (Operations for Injury of the Menisci of the Knee). Page 502.

KÖLLIKER, TH.: Eine Modifikation der Lisfranc'schen Exartikulation (A Modification of Lisfranc's Exarticulation). Page 523.

LANGE, FRITZ: Die Fernleitung bei Lämung der Glutäen (The Transmission of Power in Paralysis of the Glutei). Page 526.

Paralyzed glutei can be replaced by the action of the sacrospinalis, latissimus dorsi, and vastus lateralis muscles through the medium of long silk tendons. Cripples are enabled to walk without braces in spite of maximus paralysis, and medius limps are reduced in degree. The vastus lateralis plastic has completely abolished the abductor limp associated with some cases of coxa vara and coxitis.

LANGENSKIÖLD, F.: Über die Lockerung des Sacro-iliacalgelenkes (Relaxation of the Sacroiliac Joint). Page 535.

NATZLER, ADOLF: Zur Frage der deformierenden Veränderungen bei der unblutig behandelten angeborenen Hüftverrenkung (The Question of Deforming Changes with Closed Reductions of Congenitally Dislocated Hips). Page 547.

NILSONNE, HARALD: Über Sehnentransplantation beim paralytischen Hackenfuss (Tendon Transplantation in Paralytic Talipes Calcaneus). Page 572.

The literature covering talipes calcaneus is reviewed and discussed. Prof. Haglund's method is to reef the Achilles tendon and transplant into it the peronei, flexor hallucis longus, tibialis posterior, and flexor digitorum longus. Seventeen cases are reported in which this method was used. Eight results were good, four fair, and five poor. The suggested treatment of talipes calcaneus is as follows: under five years, braces; five to fifteen years, the above operation plus braces (in children over ten years, occasionally in combination with subastragalar arthrodesis); above fifteen years, subastragalar arthrodesis with the above operation.

ODELBERG-JOHNSON, G.: Zur Entstehung der medialen Kollumfraktur (The Mechanics of Subcapital Fractures of the Femoral Neck). Page 595.

ORELL, S.: Extremity Surgical Operating Table. Page 618.

OSGOOD, R. B.: The Classification and Etiology of Chronic Rheumatism or Arthritis. Page 634.

PLATT, HARRY: Lesions of the Semilunar Cartilages of the Knee Joint. Page 654.

A statistical study of two hundred and sixty-eight personal cases and several series from the literature emphasizes the variations in findings. A simple comprehensive classification is used by the writer. Longitudinal fracture of the medial cartilage is the most common injury, and half of these are of the bucket-handle type. True hypermobility of the medial cartilage is rare. Most non-fracture lesions of this cartilage fail to explain the mechanics of internal derangement, but if the pre-operative diagnosis has been certain, removal will likely result in a cure. Fracture of the lateral cartilage is less common than true hypermobility, which is the ordinary cause of "trigger knee".

PORT, KONRAD: Erfahrungen mit der Apparatbehandlung der poliomyelitischen Lähmungen (Experiences with the Brace Treatment of Infantile Paralysis). Page 666.

VON ROSEN, SOPHUS: Zur Frage der Zystenbildung in den Karpalknochen (The Question of Cyst Formation in the Carpal Bones). Page 681.

RYDÉN, AKE: Zwei Fälle von Spondylolisthesis (Two Cases of Spondylolisthesis). Page 696.

SCHANZ, A.: Simulation?—Neurose?—Insufficientia vertebrae traumatica? (Malingering?—Neurosis?—Traumatic Insufficiency of the Vertebrae?) Page 706.

SCHERB, R.: Zur Ätiologie kongenitaler und kongenital bedingter Fussdeformitäten mit besonderer Berücksichtigung des Pes equinovarus congenitus (The Etiology of Congenital Foot Deformities and Deformities Due to Congenital Factors with Especial Reference to Pes Equino-varus Congenitus). Page 717.

Congenital club-foot is in most cases the morphologic product of the adaptation of the foot to an early displacement of the insertion of the peroneus brevis. There is a phylogenetic connection between this muscle and the extensor digitorum pedis brevis which normally disappears in the third foetal month. This connection persists in the club-foot as a fibrous strand of variable length which is interposed between the otherwise normal tendon of the peroneus brevis and the tuberosity of the fifth metatarsal bone.

SCHOLDER, C.: Contribution à l'Etude de la Stabilisation de la Hanche par Réflection ostéoplastique du Toit du Cotyle chez les Luxés congénitaux invétérés (Stabilization of the Hip by Osteoplastic Reflection of the Roof of the Acetabulum in Inveterate Congenital Dislocations). Page 751.

SILFVERSKIÖLD, NILS: (Pseudo-) Exostosis dorsalis articularis metatarsocuneiformis I. Page 760.

SIMON, W. V.: Die Verknöcherung des ligamentum ilio-lumbale (The Ossification of Iliolumbar Ligament). Page 767.

SINDING-LARSON: Remarks on the Healing of Tubercular Coxitis. Page 791.

SORREL, ETIENNE: Contribution à l'Etude des Ostéo-Arthrites Tuberculeuses du Cou-de-pied (A Contribution to the Study of Tuberculous Osteo-arthritis of the Ankle Joint). Page 814.

SÖDERLUND, GUSTAF: Über die septische Osteomyelitis im Os pubis (Suppurative Osteomyelitis of the Os Pubis). Page 850.

TREGUBOW, S. L.: Über die Dosierung bei der Heliotherapie (The Dosage in Heliotherapy). Page 892.

TROELL, ABRAHAM: Zwei Fälle von Riesenzellentumor in Knochen beobachtet 3½ bezw. 18 Jahre (Two Cases of Giant-cell Bone Tumor Observed at Three and One-half, and Eighteen Years). Page 906.

The tumors occurred in the femur and the occiptal bone.

TURNER, H., AND MARKELLOV, N.: Die Röntgendiagnostik der Spondylolysis im Lichte experimenteller Forschung am Kadaver (The X-ray Diagnosis of Spondylolysis in the Light of Experimental Studies on the Cadaver). Page 914.

A dehiscence at one end or both ends of the fifth vertebral lamina (spondylolysis) predisposes to spondylolisthesis, lumbar scoliosis, and low back pain. Early x-ray diagnosis of this condition should be made before actual deformity occurs. Spina bifida and other congenital abnormalities may be combined with spondylolysis.

WAHREN, HERMAN: Über die Korrektur der Tibiatorsion bei kongenitalem Klumpfuss (The Correction of the Tibial Torsion of Congenital Club-foot). Page 728.

WALDENSTRÖM, HENNING: On Necrosis of the Joint Cartilage by Epiphyseolysis Capitis Femoris. Page 936.

ZUR VERTH: Die "mit Unrecht sogenannte Plattfussfrage" (The Question of the Misnamed Flat-foot). Page 947.

WHITMAN, ROYAL: The Abduction Treatment for Fracture of the Neck of the Femur. Page 952.

WILLIAM-OLSSON, GUY: Two Pairs of Twins with Rachitic Deformities. Page 957.

VULPIUS: Fragen und Antworten zur Behandlung der Knochen- und Gelenktuberkulose (Questions and Answers in the Treatment of Tuberculosis of the Bones and Joints). Page 970.

—W. P. Blount, M.D., Milwaukee, Wisconsin.

XANTHOMATOSIS (SCHÜLLER'S DISEASE—CHRISTIANS' SYNDROME). M. C. Sosman. *Am. J. Roentgenol.*, XXIII, June 1930.

Xanthomatosis is a term used by Rowland to cover a group of diseases in which lipoid metabolism is at fault. These diseases include "defects in membranous bones", "diabetes insipidus and exophthalma", "Gaucher's Disease", "Pick-Niemann's Disease (lipoid histiocytous)", and the various forms of xanthoma, xantho-myeloma, and xanthelasma. Rowland believes that these processes start with an excess of lipoid in the body tissues, which acts upon the vascular endothelium as an irritant or upon previously injured surfaces.

The group discussed here involved cholesterol. It is important to stress the point that defects in membranous bones, diabetes insipidus and exophthalmos need not all be present to establish the diagnosis. It is suggested by peculiar irregular moth-eaten defects in the bones, usually the skull, but also found in the pelvis, ribs, vertebrae, and long bones. The most common and earliest sign is involvement of teeth and gums,—*i.e.*, by an ulcerative, inflammatory process which results in the loosening of the teeth; likewise, jaundice, retardation of growth, malnutrition.

Three cases are reported. In diagnosis, x-rays show defects in skull, pelvis, and occasionally in other bones. These are distinct, with clean-cut, irregular edges, and may simulate syphilis or metastasis. But a point in differentiation is absence of a palpable tumor of size consistent with the defect. Associated diabetes insipidus and exophthalmos are due to location. There is history of trauma or infection, cessation of growth, lack of gain of weight, anaemia, frequent gingivitis and occasional jaundice. Several cases have been reported as myeloma.

Spontaneous remissions occur. Prognosis is better than of a neoplasm.—*C. S. Lowendorf, M.D., Iowa City, Iowa.*

PSEUDOFRACTURES (HUNGER OSTEOPATHY, LATE RICKETS, OSTEOMALACIA). Report of a Case. L. A. Milkman. *Am. J. Roentgenol.*, XXIV, 29, July 1930.

The author reports the case of a female aged forty, who complained of difficulty in arising from a lying or sitting position. This progressed until she could not walk because of severe pain in the upper femora. When questioned why she hesitated before arising, she stated she had no strength in her muscles. On examination, patient had no blue sclerae. Parenchymatous organs were negative; skeletal examination showed apparently normal growth of bones; no bending or deformities; no swelling, crepitation, or abnormal mobility. Tenderness was present over ribs, sternum, right ulna, and just below trochanters of both femora. Neurologic examination gave a suggestion of an atypical dystrophia myotonica. Blood urea, uric acid, creatinin, sugar were normal. At the suggestion of Prof. Bauer, of Vienna, x-rays were taken.

X-rays showed just below the greater trochanters bands of radioparency which divided the bone into two parts. Yet there was no displacement. Similar bands were seen in the scapulae, radii, ulnae, metatarsal bones, fibulae and sixth, seventh, eighth, ninth, tenth, and eleventh ribs. The lesions are multiple, symmetrical, and at right angles to long axis and, in the fibulae, lie one inch below the epiphyseal lines. This, Fromme considers typical. There is no evidence of callus formation and no separation

of the parts. The lesions start as a small punctate area which gradually encircles the entire cortex.

All forms of treatment have been negative. No history of trauma is evident. As a new part becomes involved, the patient foretells the location by tenderness.

The symptom complex, ageed upon by most authors, is:

1. Lumbosacral pain;
2. General weakness;
3. Waddling gait;
4. Difficulty in raising legs;
5. Tenderness over the skeleton, especially chest and pelvis;
6. Increased patellar reflexes;
7. Skeletal changes resembling osteomalacia or late rickets.

The differential diagnosis from similar conditions is given.—*C. S. Lowendorf, M.D., Iowa City, Iowa.*

Bone Lesions in Tardive Heredosyphilis. E. P. Pendergrass, R. L. Gilman, and K. B. Castleton. *Am. J. Roentgenol.*, XXIV, 234, Sept. 1930.

In this extremely interesting paper, the authors speak of the tendency to use the words "congenital" and "hereditary" in a synonymous way. Heredosyphilis is the term he uses to include the type of infection to the child which takes place via the placenta. Congenital syphilis should be applied strictly to that type of the disease which follows infection of the foetus in passing through the birth canal.

The paper deals with the bone lesions in late heredosyphilis. The history of this condition is gone into carefully. A table is given, representing cases of tardive heredosyphilitic bone lesions in patients of twelve years and over. Description of the skiagraphic findings in syphilis in the first, second, and third stages is given in detail; late bone manifestations occur especially between the fifth and twelfth years, involving the tibia and elbow with greatest frequency.

One case is reported; the patient had almost every possible type of bone involvement found in syphilis, all of which responded to treatment. Four additional cases from the literature are spoken of.—*Edward S. Hatch, M.D., New Orleans, La.*

Roentgenologically Demonstrable Changes in Bone in Gaucher's Disease. Report of a Case. B. R. Kirklin and H. W. Hefke. *Am. J. Roentgenol.*, XXIV, 258, Sept. 1930.

Gaucher's disease belongs to the diseases that are accompanied by more or less splenomegaly. One case is reported and twelve other cases reviewed.—*Edward S. Hatch, M.D., New Orleans, La.*

Sarcoma of the Rib. R. J. Reeves and H. H. Kasabach. *Am. J. Roentgenol.*, XXIV, 262, Sept. 1930.

Sarcomata and carcinomata of the ribs are usually not diagnosed until there is an appearance of a tumor mass. The author states that the radiographic appearance of a tumor in the rib varies from a purely destructive process to a combination of destruction with bone production radiating outward from the rib. The soft-tissue tumor can usually be seen extending about the involved ribs.

Two cases are reported. Sarcoma of the rib is to be differentiated from tuberculosis, which can often be done only with greatest difficulty.—*Edward S. Hatch, M.D., New Orleans, La.*

The Normal Position of the Patella. S. B. Boon-Itt. *Am. J. Roentgenol.*, XXIV, 389, Oct. 1930.

The work represented by this paper was undertaken because in discussion of a paper by Murk Jansen on "Genu Impressum and Patella Alta Vera", the question was raised as to what constituted the normal relation of the patella to the femur.

Nothing was found in the latter to answer this question. This study is based on lateral skiagraphs of two hundred normal adult knees. It is a very interesting mathematical problem and should be read in its entirety.

A patella may be said to be definitely high if in the lateral view of a knee in 140 degrees of extension, the lower edge of the articular surface of the patella is found to be about one-half of the patella length above the lower edge of the articular surface of the femoral condyle.—*Edward S. Hatch, M.D., New Orleans, La.*

CONSIDERATION OF THE METATARSALS AND THEIR INJURY. A. J. Buka. *Am. J, Surg.*, IX, 135, July 1930.

The author gives a short résumé of the anatomical and functional rôle of the metatarsals, and finds that fracture may be due to direct or indirect trauma and is often undiagnosed. The fifth metatarsal is most frequently injured and x-ray is advised in all cases of painful feet resulting from injury.

In consideration of treatment, absolute rest and fixation are indicated, preferably in plaster cast for at least three weeks. Guarded weight-bearing is permitted after four weeks after proper surgical care in compound fractures, and at the end of three weeks in simple fractures. Physiotherapy is used to restore function. The conservation of all possible traumatized tissue in compound fractures is also advocated.—*Custis Lee Hall, M.D., Washington, D.C.*

PATHOLOGICAL FRACTURES IN PRIMARY BONE TUMORS OF THE EXTREMITIES. B. L. Coley and G. S. Sharp. *Am. J. Surg.*, IX, 251, Aug. 1930.

Pathologic fracture is a frequent complication of a primary bone tumor of the long bones, and is often the first symptom noted. A group of 185 cases over a ten-year period was the basis of the study, and included osteogenic sarcoma, giant-cell tumor, and endothelial myeloma. The percentage of fractures in these cases was greatest—sixty-five and nine-tenths per cent. for the osteogenic sarcoma, the remaining cases being about equally divided between giant-cell tumors and myelomata. Pathologic fractures are most likely to occur in patients past the average age for the corresponding tumor.

The group showed three-fourths of the tumors in the lower extremities, while the fractures were most common in the upper extremities, and in all cases of fracture tumor preceded fracture. Life expectancy was shortened sixty per cent. in fractures of the osteogenic sarcoma group, and all cases in the giant-cell group were alive. Pathologic fractures may be postponed by early and continuous support, and failure to immobilize predisposes to early dissemination. Union followed in most cases of giant-cell tumor, and in none of the osteogenic sarcoma cases.—*Custis Lee Hall, M.D., Washington, D.C.*

STRUCTURAL FACTORS IN STATIC DISORDERS OF THE FOOT. D. J. Morton. *Am. J. Surg.*, IX, 315, Aug. 1930.

The author presents the results of his studies of the structure of the foot, and feels that the collapse of the longitudinal arch can not be attributed entirely to the lack of muscle balance between the opposing muscles of the leg and foot. The mechanical faults discussed and their influence on muscle balance are laxity of the joint between the inner cuneiform bones and between them and the navicular, shortness of the first metatarsal, posteriorly located sesamoid bones, or a combination of these conditions. Hypertrophy of the second metatarsal in its diameter is evidence of the greater stress thrown upon it as a result of the first mentioned anomalies. This was seen in cases of anterior foot trouble. Another condition is described as hypermobility of the first metatarsal bone, with separation of the inner and middle cuneiform, resulting in mechanical instability and hypertrophy of the second metatarsal. External factors are discussed and are of equal importance in producing symptoms with the mechanical factors within the foot.—*Custis Lee Hall, M.D., Washington, D.C.*

STREPTOTHRICOSIS. J. J. Singer and H. C. Ballon. *Am. Rev. Tuberc.*, XXII, 233, Sept. 1930.

The authors report a case of streptothricosis involving the vertebrae, bones of the pelvis and ribs, complicating a pulmonary lesion. The disease commenced as a cardiorenal condition, developing into a condition simulating pulmonary tuberculosis, with later changes in the skeleton.

A man thirty-two years of age complained of puffiness of the ankles, hands, and face, frequency both day and night, fatigue, pain in the right pubic region, and purpuric spots appearing on the abdomen. These symptoms came on following a rapid loss of weight of some thirty pounds. When first seen, the patient presented a picture of undoubted cardiorenal disease. This reacted to treatment and no further symptoms appeared during the time that he remained upon a strict diet; coincident with a break in diet, further symptoms developed. In the course of a study into the causation of these, six months after the onset of the original disease, an x-ray examination was made of the pelvis, which showed multiple healed fractures of the pelvic bones, atrophy of the lumbosacral vertebrae, destruction of the first lumbar and sacralization of the right fifth transverse process. A more searching history, taken at this time, brought out the fact that the patient had tripped and sat down rather heavily on the steps about three months previously. Following this accident he could not move for ten or fifteen minutes, though there was no paralysis of the limbs, and he complained of considerable pain in the back immediately after the fall.

Nine months after the onset the patient's height had decreased from five feet six inches to less than five feet, and the pulmonary lesion had become aggravated, much mucopurulent, bitter expectoration being raised. Examination showed a fluctuating area in the lower right axilla, which yielded pus on aspiration. A culture of this pus showed a pure growth of streptothrix. Two weeks later a second abscess developed in this area, which was incised and drained. A piece of rib, denuded of periostium, was found in the bottom of the cavity.

One month later (ten months after the onset) the patient died. The final clinical diagnosis was: multiple streptothrix abscesses, both lungs, with metastases to the skeleton and internal organs, compression fractures of the spine, multiple rib fractures and hypertension. Necropsy findings substantiated the final clinical diagnosis and in addition showed that few organs or tissues had been spared by the infection. In the skeleton all of the ribs on the right side seemed to have been directly involved from the infection in the right chest wall. The lesions in the bodies of the lumbar and thoracic vertebrae were so extensive as to have caused a collapse of the vertebral column. Distorted discs were the only remnants of some of the vertebrae.

In discussing the bone lesions, the author states that streptothrix has been recovered from the lesions of madura foot and similar conditions, which lesions, while common in southern Europe and Asia, have also been reported from America. The close relationship between rat-bite fever (streptothrix pyaemia) and the lesions herein described is referred to.

In differential diagnosis, consideration must be given to such specific infections as tuberculosis, actinomycosis, spirotrichosis and glanders. The pulmonary lesions may also be confused with bronchopneumonia, pulmonary abscess, mediastinal abscess, empyaema, meningitis, etc.—*Clarence A. Ryan, M.D., Vancouver, B.C.*

OSTEOPERIOSTEAL BONE GRAFTS. G. M. Dorrance. *Ann. Surg.*, XCII, 161, Aug. 1930.

A case is reported in which an extra-articular osteoperiosteal bone graft was placed from the tibia below the knee through a subcutaneous channel and attached to the femur well above the knee. This graft formed a bone bridge, shown very distinctly in a radiogram taken eighteen months later. This relieved the pain and disability of an old infected knee joint. The author claims that this type of bone graft is simpler to apply, and has the advantage of being removable should one desire to do so. He advises this type of graft in cases of jaw involvement. He performed several experiments upon dogs. Some were successful, others not.—*F. G. Hodgson, M.D., Atlanta, Ga.*

NON-EFFECT OF IRRADIATED ERGOSTEROL IN THE TREATMENT OF FRACTURES. K. M. Lewis. *Ann. Surg.*, XCII, 415, Sept. 1930.

Seventeen cases of fracture of the shafts of long bones were studied in the Bellevue Fracture Clinic. X-rays and studies in blood calcium and phosphorus were made. There were six cases of delayed union.

Conclusions: 1. Irradiated ergosterol does not hasten union or callus formation in fractures in adults.
2. It does not materially raise the calcium or phosphorus in the blood.
3. No benefit was noted in cases of delayed union.
4. It can not be considered of value in the treatment of fractures in adults.—*F. G. Hodgson, M.D., Atlanta, Ga.*

MULTIPLE MYELOMA AS A SINGLE LESION. C. F. Geschickter. *Ann. Surg.*, XCII, 425, Sept. 1930.

Two cases are reported in which there was only a single lesion. These occurred in adults over thirty-five years of age; were distinctly medullary and bone destructive in character. The lesion is always confined to the red-marrow bones. The author discusses the differential diagnosis from giant-cell tumor, metastatic carcinoma, Ewing's sarcoma, bone cyst, and other bone tumors.—*F. G. Hodgson, M.D., Atlanta, Ga.*

INTRA-ARTICULAR ENDOTHELIAL TUMORS ARISING FROM SYNOVIAL MEMBRANE. Lewis C. Wagner. *Ann. Surg.*, XCII, 421, Sept. 1930.

The author reports two cases of a rare condition, the pathology of which shows that the tumor mass is composed of peculiar, elongated, blunt cells, sometimes fusiform in shape. Grossly, they resemble synovia with a brownish-yellow color, and are tough. The tumor is encapsulated and is attached only to synovial membrane. The rest of the joint is normal. No metastasis is reported, but in one case there was recurrence until amputation was necessary.—*C. S. Lowendorf, M.D., Iowa City, Iowa.*

MUSKELBEFUNDE UND IHRE BEDEUTUNG BEIM ANGEBORENEN KLUMPFUSSLEIDEN (Muscle Findings and their Significance in Congenital Club-foot). C. Mau. *Arch. f. Orthop. u. Unfall-Chir.*, XXVIII, 292, 1930.

The author has made an anatomical study of two specimens of congenital club-foot.

In a foetus of eight months (length forty centimeters) a spina bifida was found in the lumbar region and both feet were in the typical club-foot position. Examination of the musculature showed, grossly, marked under-development of all muscles of the legs except the triceps surae on each side. Microscopic examination showed a normal condition of the hip and thigh muscles, with the exception of the biceps femoris which was in part normal and in part showed moderate atrophic changes. The triceps surae was only mildly affected by the atrophic process. The other muscles of the leg—extensors, pronators, flexors, and supinators—showed variable degrees of atrophy, most marked in the tibialis posterior. In none of the sections was the process so extensive that it could be classified as a degenerative atrophy.

In a specimen of a six months' foetus (length thirty centimeters) a bilateral club-foot was present. The spine showed no abnormalities, as determined by palpation and roentgen examination. The musculature of the legs showed no abnormalities microscopically except a slight narrowing of the muscle fibers.

In conclusion, the author agrees with Böhm that the mild form of club-foot is due to a developmental arrest, a pathologic fixation in a primitive stage of development. However, the severe forms of club-foot, with a marked displacement of the navicular to the medial side of the talus and with adduction of the forefoot, are probably produced by a supplementary action of the muscles, especially the tibialis posterior, in addition to the developmental arrest. Between the mild and the severe forms of club-foot all intermediate stages are possible, depending on the mild or severe disturbance of development

of the muscles. The distribution of muscular changes is best explained by assuming a developmental disturbance of the medullary plate.—*R. J. Dittrich, M.D., Wichita, Kans.*

OSTEOMALACIA AND FOETAL RICKETS. J. Preston Maxwell. *British J. Radiol.*, III, 375, Aug. 1930.

The author outlines the definition and clinical findings of osteomalacia; in doing so he classes the disease as an adult type of rickets, connected with deficiency of vitamin D and an actual calcium starvation.

The disease, although one of osteoporosis, must be distinguished from other diseases causing this phenomenon,—*viz.*, hyperparathyroidism, pseudo-malacia malignum, rare cases of hyperthyroidism, and osteitis fibrosa. The blood calcium and phosphorous are usually lower than normal. This is not always the case. Obviously, tetany may be present.

The deformities likely to be present are classed as those involving the chest, the pelvis, and the long bones. They may be present in various combinations. Fractures, single or multiple, and relatively less painful, occur more readily in the long bones in addition to bending.

X-ray diagnosis is often easy, but in milder cases it is not of specific value. However, progress in healing may be so checked. Skiagrams of foetal cases of rickets are presented; these infants were born to mothers having osteomalacia. Typical findings of rickets were present at birth, and cleared up when the mother was given adequate treatment.

For treatment, large doses of cod liver oil (one and one-half to two ounces daily), plus viosterol and the usual specific treatment for rickets, is suggested. The prophylaxis is obvious. —*D. C. Leavitt, M.D., Iowa City, Iowa.*

ENDOTHELIOMA OF THE CAUDA EQUINA (Report of a Case with Removal of Tumor and Recovery). Cecil P. G. Wakeley, C. Worster-Drought, I. M. Allen, and W. E. Carnegie Dickson. *British J. Surg.*, XVIII, 6, July 1930.

The above authors report a case of epithelioma of the cauda equina.

The symptoms were those of increasing pain in the left gluteal region and back of left thigh for nine months. Coughing caused a spasmodic movement of the left leg.

Examination showed wasting and weakness of the muscles of the left leg and thigh. The right knee jerk was more active. The spinal fluid taken from the third lumbar interspace showed evidence of blocking of its circulation. X-ray examination following the injection of lipiodol showed a block at the level of the third lumbar vertebra.

At operation a semicystic tumor was found at the level indicated by x-ray. It was lying in front of the cauda equina and to the left of the mid-line. Pathologic examination showed the tumor to be an endothelioma.—*H. P. Worstell, M.D., Iowa City, Iowa.*

THE HINGED BONE GRAFT. Arnold K. Henry. *British Med. J.*, I, 737, Apr. 19, 1930.

Henry describes the special form of operative technique he uses for the treatment of paralytic unstable feet. He calls it the hinged bone graft. The operation consists in the implantation of an osteoperiosteal graft into a groove in the back of each malleolus. The graft is curved to run forward on either side of the tarsus to a point just beyond the midtarsal articulation. Movements at the ankle are permitted during convalescence with the object of producing a point of non-union in the resulting bone strip. The plan is to produce an internal splint similar in structure and function to a knee cage. Three cases are very inadequately reported.—*R. I. Harris, M.B., Toronto, Canada.*

TREATMENT OF BONE TUBERCULOSIS BY LARGE AMOUNTS OF VITAMINS A AND D. C. Lee Pattison. *British Med. J.*, II, 178, Aug. 2, 1930.

Pattison records the results of the treatment of forty-three cases of bone tuberculosis with large amounts of vitamins A and D as compared with the treatment of

thirty-five similar cases with cod liver oil. His conclusion is that vitamins A and D are not of more curative value for this disease than is cod liver oil.—*R. I. Harris, M.B., Toronto, Canada.*

TWO CASES OF BONE TUMOR FROM ANCIENT EGYPT. R. A. Gardner and A. L. Urquhart. *British Med. J.*, II, 211, Aug. 9, 1930.

Gardner and Urquhart describe two interesting specimens of bone tumor found by the archaeologist, Guy Brunton, in dynastic and predynastic graves in Egypt. The first is an osteosarcoma of the femur of a young individual. The x-ray appearance is unmistakable. The second is a tumor of the mandible, probably an epulis. Excellent illustrations accompany the article.—*R. I. Harris, M.B., Toronto, Canada.*

CONGENITAL RADIO-ULNAR SYNOSTOSIS. David J. Davies. *British Med. J.*, II, 557, Oct. 4, 1930.

Davies reports two cases of congenital radio-ulnar synostosis, one bilateral and one unilateral. Both were interesting from the fact that injury first directed attention to the disability. The disability was attributed to injury. No family history of similar deformities could be obtained in either case.—*R. I. Harris, M.B., Toronto, Canada.*

FRACTURES OF THE PATELLA. R. Watson Jones. *British Med. J.*, II, 592, Oct. 11, 1930.

Jones stresses the true aim of treatment of injuries to the extensor apparatus of the knee,—*viz.*, the attainment of a perfectly functioning knee. He rightly states that this involves early movement of the joint as well as accurate and secure replacement of the bony fragments. Hence all fractures of the patella should be treated by open operation. By no other method can the fragments be secured in apposition in such a manner as to permit movement. He uses braided silk to suture the fragments. His method of placing the sutures has much to recommend it. In rupture of the ligamentum patellae he repairs the torn ligament with fascia lata. There is a curious misstatement of fact in the statement that fascia lata makes undesirable suture for fractured patella because it is "elastic".—*R. I. Harris M.B., Toronto Canada.*

OBSERVATIONS ON THE TREATMENT OF CONGENITAL DISLOCATION OF THE HIP. H. P. H. Galloway. *Canadian Med. Assn. J.*, XXIII, 650, 1930.

Manipulative reduction is undoubtedly still the method adopted by the majority of surgeons in treating young patients. Some use the original Lorenz technique, others a modification,—such as the Denucé method. There seems to be abundant evidence that in the hands of experienced operators a large proportion of young patients can be permanently cured by manipulative methods. In 1904 Sherman criticized Lorenz' technique and results, emphasizing the capsule constriction, muscle laceration, hematoma, etc., and voicing the opinion that "good anatomic results" were obtained in not more than half the cases.

How, then, explain the many undoubted cures by manipulation? Probably a wall of soft tissue is pushed before the head, and this gradually disappears by pressure absorption.

The surgery of thirty years ago was largely manipulative; today the orthopaedic surgeon is a trained operator. If he has adequate hospital facilities, the habit of asepsis, and his patients are from twenty to thirty months old and have not been treated previously by manipulation, open operation is the method of choice. Previous attempts at closed reduction produce scarring and lowered resistance in the tissues, and thus do not give the open method a fair showing. In the writer's opinion, the traumatism of open reduction is less than that of manipulation.

As regards after-treatment, Denucé did not allow walking for about one year, and followed an elaborate course of after-care. In contrast with this, open reduction permits of walking within a month and plaster is discarded after six months. While operation is carried out on children as young as nineteen or twenty months, two to two and

one-half years is the ideal age. The operation becomes more difficult as age advances.

Treatment of older patients. Open reduction may be attempted, provided the soft parts be lax enough. Preliminary traction is valueless. Division of the iliopsoas and subcutaneous section of the adductors and of the iliotibial band may assist in setting the head near the acetabulum; it may then be shoe-horned into place. Where there is little movement of head on ilium, the method of turning down a layer of bone from the ilium and wedging it by bone chips is probably the simplest and safest. Hey Groves has suggested reaming out a new acetabulum, sewing the capsule over the head, and implanting this in the newly formed socket.—*A. Gibson, M.D., Winnipeg, Canada.*

LIVING SUTURES IN RECENT FRACTURES OF THE PATELLA. Dudley E. Ross. *Canadian Med. Assn. J.*, XXII, 785, June, 1930.

The author has followed-up the work of Gallie and LeMesurier. Eight cases of fractured patella were operated on. The fragments were fixed in apposition by running the fascial strip through drill holes in the bone, the needle then being introduced through the free end of the fascial suture. The latter was then drawn taut, and the remainder of the suture employed in bringing the edges of the capsule into apposition. No fixation was used. At the end of forty-eight hours, the patients were encouraged to flex and extend the leg.

The author gives his case reports with good results. He mentions the value of fascia. Its tensile strength is greater than that of chromic catgut. Active movement can be started early.—*M. E. Pusitz, M.D., Iowa City, Iowa.*

MULTIPLES MYELOM, SPONDYLARTHRITIS DEFORMANS UND SENILE OSTEOPOROSE AN DER WIRBELSÄULE (Multiple Myeloma, Spondylarthritis and Senile Osteoporosis of the Vertebral Column). Ulrich Spiller. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, XLII, 191, 1930.

The x-ray demonstration of multiple myeloma is commonly based on the presence of more or less characteristic punched-out areas. Geschickter has called attention to a variety of diffuse changes which impart an osteoporotic character to the involved bone. Spiller urges the early examination of the spine because symptoms here appear comparatively soon in the progress of the disease, whereas large lesions of the bones of the extremity may persist for long periods unnoticed. In fact, these lesions of the long bones may be first noticed in the course of a spontaneous fracture. It follows that an endeavor should be made to describe the roentgenologic picture of multiple myeloma metastasis to the spine.

The usual localized area of loss of density cannot be recognized in the vertebra with any assurance. Even when the vertebra is riddled with neoplasm, only a diffuse osteoporosis appears, which, in patients of advanced age, seems to carry no significance. For this reason, two cases of the author were recognized only on the necropsy table. Comparison of the sectioned spines with the ante-mortem x-ray, as reproduced, emphasize the difficulty of recognizing areas of tumor replacement in vertebrae. The presence of irregular compression of the body, of general decrease in density, the absence of lipping, should help in determining whether the case is simply one of senile osteoporosis or whether it is a case of malignancy. The suspicion of myeloma should be aroused in cases in which a generalized osteoporosis of the vertebrae is present without evidences of proliferative changes. Further x-ray studies and examination of the urine for Bence-Jones bodies would then be advisable.—*Jos. E Milgram, M.D., Iowa City, Iowa.*

FOREIGN BODIES IN THE ELBOW JOINT ("Baseball Pitchers' Elbow"). F. J. Kirby. *J. Am. Med. Assn.*, XCV, 404, Aug. 9, 1930.

Two cases of the so called "baseball pitcher's" elbow are reported. The injury is caused by throwing a base ball, at the same time quickly extending the elbow. There occurs a chip fracture from the posterior inner surface of the radius. The symptoms are acute, and the patients usually state they "threw the elbow out". Pain, swelling

and limitation of motion quickly set in. The treatment is operative removal of the fragment. The results in both cases were good.—*J. Kulowski, M.D., Iowa City, Iowa.*

OSTEOMYELITIS OF THE SKULL (Report of Cases Occurring as a Result of Frontal Sinus Infection with Staphylococcus Pyogenes-aureus). Fletcher D. Woodward. *J. Am. Med. Assn.*, XCV, 927, Sept. 27, 1930.

The author reviews the literature and statistics of osteomyelitis of the skull during the past thirty years, and after a brief discussion of the etiology, pathology, symptoms, and treatment, reports three cases in detail, making a total of fifty-eight cases in the literature to date.

His discussion is confined to those cases complicating frontal sinus infection. He is impressed with the lack of bacteriologic study of twenty cases. One was due to pneumococcus (with recovery), five were due to streptococci (all patients died), and fourteen were due to staphylococcus pyogenes-aureus (three patients died). This gives a mortality of only twenty-one per cent.

He believes that most cases of osteomyelitis of the skull complicating frontal sinus infection are due to staphylococcus pyogenes-aureus and that the pathology is fairly constant. Treatment should be prompt, radical operation and surgical solution of chlorinated soda is advocated.—*W. B. Carrell, M.D., Dallas, Texas.*

STREPTOCOCCAL INFECTIONS OF THE EPIPHYSES AND SHORT BONES (Their Relation to Köhler's Disease of the Tarsal Navicular, Legg-Perthes' Disease and Kienböck's Disease of the Os Lunatum). B. Phemister, Alexander Brunschwig and Lois Day. *J. Am. Med. Assn.*, XCV, 995, Oct. 4, 1930.

Observations and bacteriologic studies made on biopsy material from two cases each of Köhler's disease of the tarsal scaphoid, Legg-Perthes' disease, and Kienböck's malacia of the os lunatum, suggest to the author that streptococci play an important rôle in the etiology of these diseases, but that other factors may also bring them about. Whether the streptococci reach the bone in an embolus which blocks the main artery or whether they lodge there above remains undetermined.—*W. B. Carrell, M.D., Dallas, Texas.*

ORTHOPEDIC ASPECTS OF CHRONIC RHEUMATISM OR ARTHRITIS. R. B. Osgood. *J. Am. Med. Assn.*, XCV, 992, Oct. 4, 1930.

The author accepts the atrophic and hypertrophic classification of acute and chronic arthritis, and in discussing each brings out clearly the salient differential points.

The atrophic type is characterized by early proliferation of the synovial membrane, osteoporosis, atrophy of the muscles controlling motion of the joints, pannus formation, and frequently ends in bony ankylosis. Age incidence is from birth to middle life.

Early fibrillation of the articular cartilage, not evident in the roentgenogram, and lime salt deposits in the form of chondro-osseous spicules at the articular margins, together with lack of atrophy, characterize the hypertrophic type. The age incidence is from middle life to death.

The author discusses the importance of good body mechanics, the prevention of deformities, maintenance of joint motion, and local treatment in the handling of these cases.—*W. B. Carrell. M.D., Dallas, Texas.*

NEW PROBLEMS OF THE ORTHOPEDIC SURGEON. C. B. Francisco. *J. Am. Med. Assn.*, XCV, 1467, Nov. 15, 1930.

The author feels that more interest is being shown the crippled child today than ever before, and that the tendency is to carry the work to the communities rather than take the child to orthopaedic centers. If this plan materializes, he recognizes a definite responsibility in the teaching of orthopaedic surgery to medical students. They must be taught the principles of orthopaedic surgery and how to care for the ordinary congenital and acquired deformities.

The other problem he mentions is the demand industrial surgery is making for shorter hospitalization, quicker return to duty, and earlier adjustment of claims. Insurance companies know nothing about medical ethics and the author urges cooperation between the orthopaedic surgeon and the insurance company, and the willingness of each to see the viewpoint of the other.—*W. B. Carrell, M.D., Dallas, Texas.*

CONCERNING NEURITIS IN POTT-DUPUYTREN'S FRACTURES OF THE LEG. N. S. Markellov. *J. sovremennoi Chir.* (Latin transcription), IV, 1127, 1929.

Among various nerve complications accompanying bone injuries of the distal fragments of the extremities, there is one observed in the course of Pott-Dupuytren's fracture. Persistent pain is then observed, with swelling, decalcification of bones, and different other disturbances. All these phenomena reveal an irritation of a nerve trunk which, by reflex action, produces the above described clinical picture. A strictly limited area of hyperaesthesia, observed over the middle and posterior parts of the plantar surface, guides one to the source of this irritation. This area receives its innervation from the calcanei mediales, branches of the tibialis posterior behind and above the medial malleolus.

Dr. Markellov made a study on cadavera, and showed that in ten per cent. of all cases the branches of the calcanei mediales are terminals of a special nerve trunk given off by the tibialis posterior on a varying level, sometimes in the middle of the leg and sometimes higher. It is firmly attached to the tibia and can therefore be easily injured by the sharp fragment of the diaphysis after fracture of the medial malleolus.

The treatment consists in excision of this highly sensitive trunk or in blocking it with alcohol.—*Emanuel Kaplan, M.D., New York, N.Y.*

EXTRA-ARTICULAR BONE TRANSPLANTATION AS A PRINCIPLE IN THE TREATMENT OF BONE TUBERCULOSIS. Sch. D. Chachutow. *J. sovremennoi Chir.*, V, 747, 1930.

The previously accepted conservative treatment of bone and joint tuberculosis is gradually being replaced by the new operative procedures which seem to offer excellent results. The author's conclusions concerning the effects of the operative treatment are:

1. The primary importance of the mechanical immobilization in the operative treatment of bone and joint tuberculosis is regarded as questionable.

2. The mechanical factor must be considered as secondary, while of first importance are the *irritation* and the *increased* biologic processes which result from the trauma in the course of the operations.

3. Every trauma artificially applied near the tuberculous process must act beneficially upon the latter.

4. The transplantation of bone into the joint epiphysis according to Lavalle's and other methods or, better, extra-articularly, offers an additional stimulus to the maintenance, and to local irritation; it also adds a new stimulus for the increase of calcium content in the blood, and the deposit of such calcium in the affected region, which is usually deficient in calcium deposits.

5. All methods of treatment of joint tuberculosis based upon the principle of inflicted trauma during the act of bone transplantation, are, in the final results, equally beneficial. They all act as stimulants in local and general calcification of the process. The choice of the method should fall, however, upon the extra-articular, because of the easier technique and lesser danger of secondary infection, and of other complications which may arise from implants into joints and epiphyses.

6. The earlier the operation of bone transplantation is performed, the better the results to be expected. Timely interference and subjection to the mild operative trauma are important items.

7. The idea, advanced by the author, that the bone transplant acts chiefly as a mechanical stabilizer, offers a new outlook into the field of treatment of tuberculous joints. The operative procedure, with its accompanying mild trauma, must be regarded from the viewpoint of a local irritation and inflammatory reaction which stimulates and

increases the biologic process generally and locally. On these bases does the author explain the splendid results obtained after Albee's operation on spinal tuberculosis. Albee's explanation that his transplant is merely a mechanical method of immobilization, does not satisfy the author. The mechanical factor he considers only of secondary value. —*A. Gottlieb, M.D., Los Angeles, Calif.*

IMPROVEMENT OF POSTURE. M. F. Forrester-Brown. *Lancet*, II, 115, July 12, 1930.

Extension and hyperextension of the spine are much limited to the cervical and lumbar regions; only the parts of the thoracic spine adjacent to these other regions participate. Kyphosis with apex at the seventh thoracic vertebra cannot be effectively reduced by voluntary hyperextension exercises of the whole spine, for the mobile cervical and lumbar regions absorb the whole stress. Lock these two regions in flexion or put them out of action by suspension, and then you may use a hyperextending force.

The author discusses the relationship of the anterior abdominal wall and spinal column to the abdominal cavity. There are different types of "build". She discusses the "pelvic tilt". No type of shoulder exercise will put the thoracic spine into a correct attitude until the lower limbs, pelvic girdle, and lumbar spine are successively put into the correct relationship with one another.

Joints depend for their protection from constant strain on the tone of the muscles (sudden jerks on the ligaments). The sacro-iliac joints are not directly supported by any powerful muscle group and yet are subject to the stress of the whole weight of the trunk and upper limbs. Hence, balance is important to reduce strain. Similar stresses on lumbar and lumbosacral articulations are apt to be followed by reaction in the joints, which lie in intimate relationship with the roots of the nerves of the lumbar and sacral plexuses, so that symptoms are often referred to the lower limbs although the seat of the trouble is in the back. Similarly with sciatica.

She next considers "muscle balance". The nerve control of balance is chiefly maintained by a series of reflexes which are outside the control of volition and which can be modified only indirectly. The sensory receptors for these reflexes are mainly in the eyes and labyrinth, and the reflexes are directed to maintaining the eyes in a horizontal position. The basis of function is to build from below to attain this.

She concludes:

1. Increase of any one of the normal curves of the spine is associated automatically with increase of the other two, and in correcting them it is essential to begin with the lowest curve, so that the natural reflexes may assist instead of hinder the reduction of the other two.

2. Lumbar lordosis has a pernicious effect on the abdominal organs, kyphosis on the expansion of the lungs, and cervical lordosis on the heart and respiration.

3. All corrective exercises must aim at increased nerve control and balance, and defects of muscle tone must be treated by a due proportion of rest, while the extensors of the spine cannot be usefully developed apart from the abdominal muscles.—*M. E. Pusitz, M.D., Iowa City, Iowa.*

ON THE VALUE OF RAMISECTION IN CASES OF SPASTIC WEAKNESS. C. P. Symonds, *et al.* *Lancet*, II, 127, July 19, 1930.

This is a report made by ten independent witnesses upon six cases in which the operation was performed by Royle himself, while visiting England in 1927. These cases were examined from time to time following the operation. The results of the six cases are given individually.

They conclude:

1. The operation of cervical or lumbar ramisection as performed by Mr. Royle is without effect upon the rigidity from extra-pyramidal disease.

2. Rigidity of pyramidal disease is temporarily diminished after operation in both upper and lower limbs, with some improvement of voluntary power. This is short lived. The original condition recurs within a few weeks or months. They consider the

effect no more than may be seen after any major surgical procedure with postoperative shock.

3. Therefore it is of no value in the treatment of spastic weakness.

4. Sympathetic fibers play no rôle of any importance in the maintenance of muscular rigidity, whether this be of the so called Parkinsonian or pyramidal type.—*M. E. Pusitz, M.D., Iowa City, Iowa.*

THE INTRADERMAL TUBERCULIN TEST. James Maxwell. *Lancet*, II, 289, Aug. 9, 1930.

The author discusses the technique of preparation and injection of the material. Fresh material should be used. He always uses controls. The maximum reaction occurs in forty-eight hours. Whereas a simple erythaema without swelling was associated with cases which may or may not be tuberculous, swelling without erythaema, which occurred rarely, was almost invariably associated with proven tuberculosis. He discusses an arbitrary standard of interpretation. He discusses four groups of cases and the results. He concludes that in proven chronic tuberculosis the test is usually positive, whereas in apparently non-tuberculous cases the percentages of positive results is smaller. The size of the reaction is no criterion to the activity of the lesion,—in the more severe broken-down cases, reaction is mild.

A positive result does not prove tuberculosis; there may be a small tuberculous focus in addition. The swelling is probably anaphylactic and, therefore, the result of a previous sensitization to the toxins of the tuberculosis. The area of erythaema is not specific.

A positive test is but one link in the chain of evidence; a negative reaction is of more value in the exclusion of tuberculosis.—*M. E. Pusitz, M.D., Iowa City, Iowa.*

A CASE OF IMPENDING ISCHAEMIC CONTRACTURE. H. P. Nelson. *Lancet*, II, 795, 1930.

Volkmann's contracture is due to an anoxaemia of the muscle tissue. It may follow occlusion of the main artery in the proximal segment of a limb; it can also be produced by venous obstruction. This venous obstruction may be due to external pressure, tight splints or bandages. Subfascial laceration with possibly the tearing of a small artery at the time of injury, or bruising of the forearm muscles during reduction of a fracture will produce a subfascial effusion, and acute flexion of the elbow will help further to embarass the circulation.

The case described presented classical signs,—supracondylar fracture, brawny induration gradually increasing, persistent severe pain, cyanosis of the hand, and limited voluntary flexion of the fingers. The patient was a girl aged nine, who had a supracondylar fracture with backward displacement. Fracture was reduced after two hours, under general anaesthesia. After six hours the arm became painful and strapping was removed; flexion at elbow was diminished. After eight hours the arm was more painful, and induration increased. After ten hours it appeared as if gangrene would occur. Pain was not decreased; hand and forearm cold to touch; skin dusky blue; blebs forming; whole limb swollen from shoulder to fingers; anaesthesia of volar surface of index finger. After eleven hours a four-inch longitudinal incision was made on the medial side of front of elbow; skin was so tight it appeared to split. The incision was continued through the deep fascia, which was as tightly stretched as the skin. A small spurting artery was found in the depths of the wound. Both median nerve and brachial artery were found nipped between the surfaces of the fracture. These were released. The margins of the incision could not be drawn together.

The induration in the arm disappeared within three days, and in ten days the limb had returned to its normal size. Voluntary movement of the ring and little fingers was always normal. Flexion was limited in the middle finger and absent in the index finger. There was wasting and paralysis of the thenar eminence. After three months of complete fixation at eighty degrees the movements began to return. The flexion of the fingers and the action of the thenar muscles was normal. After six months there was about thirty degrees of movement in the elbow joint. After twelve months there is about fifty degrees of movement.

Many writers have referred briefly to the prophylactic treatment of this condition by early incision of the deep fascia, but there are few recorded cases where it has been carried out. The best results are obtained from operations performed within the first twelve hours; after twenty-four hours complete recovery is unlikely. The incision should be three to four inches long over the area of greatest tension, and the deep fascia must be divided to expose the muscles.—*A. Gibson, M.D., Winnipeg, Canada.*

TUBERCULOUS DISEASE OF THE SPINE. Wilfred Vickers. *Med. J., Australia*, II, 251, Aug. 23, 1930.

In the treatment of tuberculous spondylitis, the author feels that the best published results have been those obtained by spinal fusion by the method of Hibbs. He believes that there have been published no series of cases treated conservatively over sufficiently long periods of time to afford an adequate estimate of the efficiency of this method,—this because of lack of facilities for prolonged hospitalization. Patients discharged in jackets or braces after hospitalization for six to twelve months are prone to return with an extension of disease. Where children can remain in hospital until cured, he thinks conservative treatment will prove just as efficient as operative treatment.

Fusion undoubtedly shortens the necessary period of recumbency and should be attempted in all patients over twelve years of age. Exposure to sunlight improves the general condition and also increases the deposition of lime salts in the disease area, leading to earlier ankylosis.

The author has abandoned plaster casts because they interfere with heliotherapy, depending instead on the Bradford frame, the double Thomas hip splint, and Rollier straps, and, later on, leather or celluloid jackets and back braces. Patients are kept in bed eighteen months to two years or longer. X-rays are taken every four months, and after two successive radiograms show no increase of lesion, but signs of healing, a jacket or brace is made and the patient gradually allowed up. With any recurrence he is again put to bed. The support is worn for two to three years.

A small kyphos rarely increases, but a considerable one usually bends more when the patient gets up. Abscesses should be left alone unless very large, when they should be aspirated and injected with Calot's fluid. Sinus formation greatly reduces the chance for recovery.—*Edward N. Reed, M.D., Santa Monica, Calif.*

PAINFUL SHOULDER. W. J. Stewart McKay. *Med. J., Australia*, II, 301, Aug. 30, 1930.

The author designates as "painful shoulder" a condition usually called subacromial bursitis, believing that the seat of the trouble is in the tendon of the supraspinous muscle, and that bursal involvement, when present, is secondary. The patient complains of pain in the region of the subdeltoid bursa, sudden and severe, or gradual and subacute. The theory of its causation is a pinching of the supraspinatus tendon between the greater tuberosity and the coraco-acromial ligament by a blow or strain from a fall or heavy lifting, when the arm is abducted; or by repeated occupational trauma, as in typing, piano playing, etc. The theory of a bacterial or a toxic origin is also advanced.

The pain is limited to the deltoid region or extends down the arm. There are tender spots under the edge of the acromion and around the greater tuberosity. There is pain on abduction in the arc between seventy-five degrees and ninety degrees, the arc in which the supraspinatus acts. Adduction and inward rotation also increase the pain. The elbow is kept close to the chest wall, the hand supported by the sound hand. Temperature and swelling are absent, but limitation of movement and atrophy of the shoulder are present.

The tissue changes in the tendon include interference with the blood supply, partial necrosis and, finally, deposition of lime. The condition rarely affects those under thirty; typists and pianists are predisposed. The calcareous deposit in the supraspinatus tendon may show in the radiogram. However, the symptoms may be present without calcareous deposit, and in its presence they may be relieved without its removal. This condition tends to recover, in time, spontaneously, but untreated may persist for years.

Conservative treatment should first be tried. Rest, secured by fixation in plaster cast or splint, in full abduction and slight external rotation, should be the first measure. Massage gives good results. Heat is used by some but declared contra-indicated by others. These failing to relieve, injections of thirty minims of quinin and urea hydrochlorid, four per cent., should be made into the muscle, and repeated every twenty-four hours until the pain is relieved. If injections fail, an incision should be made through the anterior deltoid to expose the bursa. The calcareous deposit is found beneath the floor of the bursa, around the supraspinatus tendon. It should be removed with a curette and the wound drained.—*Edward N. Reed, M.D., Santa Monica, Calif.*

Die Erkennung und Behandlung der Epidemischen Kinderlähmung im Frühstadium (The Diagnosis and Treatment of Epidemic Anterior Poliomyelitis in its Early Stages). Fritz Lange. *Münchner Med. Wchnschr.*, LXXVII, 1395, Aug. 15, 1930.

The author points out that American experience in this disease is too little known in Germany. He describes the Flexner-Noguchi organism; and gives the incubation period as two to thirty-three days with an average of seven to fourteen days.

Lange describes the clinical signs and symptoms.

Some begin with upper respiratory disturbances; others with disturbances of the alimentary canal. There may be diarrhoea or extreme constipation. The fever is not high, but the pulse is fast. Diagnosis is difficult in the first few days. Draper and MacAusland consider the eye changes important. The children are anxious and peevish. Irritability and hyperaesthesia speak for early meningitis. Sweats occur in the early stage. Attempts to flex the body result in severe pain; the spine is held stiffly (Draper). Cerebrospinal fluid examination determines the diagnosis. Later, disease of the anterior horn cells is apparent, paralysis occurs, with increased reflexes. Hyperaesthesia and anaesthesia are described; bulbous and cerebral forms are also described. He stresses the fact that paralysis of the spinal muscles and the abdominal muscles is often overlooked. Galvanic and faradic currents are not required for diagnosis. Examination of the patient is described. Abortive forms are mentioned; Landry's paralysis is described. Intracerebral injection into monkeys has not come into practice as yet in Germany.

Diagnosis of sporadic cases is difficult. He gives the important signs and symptoms aside from paralysis. These are: hyperaesthesia, strong tendency to sweat, glassy eye, spontaneous movements of the shoulders and legs, Draper's spine sign, and stiff neck. Lumbar puncture is important and is shortly discussed.

In the next issue he will consider prophylaxis and therapy.—*M. E. Pusitz, M.D., Iowa City, Iowa.*

Symptoms and Signs of Tumors Involving the Spinal Cord. James B. Ayer. *New England J. Med.*, CCIII, 295, Aug. 14, 1930.

This is a study of sixty-four cases found at operation and autopsy, including eighteen of intramedullary tumor (glioma), thirty-three of meningioma, four of extradural hemangioma and sarcoma, and nine cases of chondroma.

There follows an analysis of the symptoms. The writer urges earlier diagnosis and operation because of the excellent postoperative results.—*J. Kulowski, M.D., Iowa City, Iowa.*

The Physiological Basis of the Surgery of the Sympathetic Nervous System J. F. Fulton. *New England J. Med.*, CCIII, 555, Sept. 18, 1930.

In his discussion on spastic paralysis, the author states that the sympathetic system is not essential for the maintenance of the normal reflex posture or the exaggerated postures of spastic paralysis. Nevertheless, some careful observers have reported benefit in some cases, and this cannot be entirely overlooked. There is a definite secondary influence present aside from the vasodilation.

For periarterial stripping the author has no defense save that it does definitely allay pain. There are sensory fibers but no vasoconstrictor fibers present in the adventitia. Experimentally, this has been proven conclusively, with the exception of the carotid.

In conclusion he states that ischaemia is the chief physiologic indication for ramisection. Collateral circulation is much more readily established following ramisection; also, it offers further possibilities, and should be done before amputation is contemplated in early gangrene from thrombosis.—*J. Kulowski, M.D., Iowa City, Iowa.*

FRACTURE OF THE TRANSVERSE PROCESS OF THE FIFTH LUMBAR VERTEBRA. Julius L. Levy. *New Orleans Med. and Surg. J.*, LXXXIII, 110, Aug. 1930.

One case of fracture of the transverse process of the right fifth lumbar vertebra is reported. This was due to muscular action,—the patient lifted the tail of an airplane.

The author states that in review of the literature he could find no similar case. He feels that even marked lateral displacement of the fragment is of less consequence than vertical displacement.—*Edward S. Hatch, M.D., New Orleans, La.*

DOSAGE IN HELIOTHERAPY. S. L. Tregubov. *Orthopedia i Travmatologia*, I, 6, 1930.

The author reviews the variety of opinions in the treatment of joint tuberculosis, and stresses the uncertainty of the problem. Heliotherapy is beneficial in various affections; however, its effect is lowered by unsystematic use, which at times may prove to be quite harmful.

The treatment is based on the rule that the optimum of effectiveness does not correspond to the maximum of sun radiation, and consists of the sun bath proper, air bath, and rest. The duration of each is individualized. The time of exposure varies with the type of the patient, the period of the year, and the hour of the day. To regulate the sun radiation, the author uses gauze shades of different thickness. The importance of not overheating the patient is stressed. The patient is exposed to the sun first, then he receives an air bath, and this is followed by rest; the entire procedure is repeated a few times, thus giving the vasculo-nervous system of the skin an adequate stimulation, followed by rest.

The author finds that the maximum pigmentation does not correspond to the best results. Time exposure tables differing from those of Rollier are appended.—*Emanuel Kaplan, M.D., New York, N.Y.*

THE OPERATIVE TREATMENT OF FLAT-FOOT. M. J. Kuslik. *Orthopedia i Travmatologia*, I, 44, 1930.

After a review of the closed and various open methods for correction of flat-foot, the author comes to the conclusion that the final indication for operation is dictated not so much by the degree of anatomical deformity as by the persistence of pain which does not yield to conservative manipulations. The flattened arch, the pronated foot, the overstretched ligamentous apparatus, and the periodic fatigue of the weakened muscles of the leg, all tend to stretch the medial plantar nerve, with subsequent ascending neuritis and trophic disturbances. Thus the operative procedure will consider the removal of the causes of neuritis,—namely, the flattening of the arch and pronation of the heel.

The author divides all cases into three groups: flat feet without bony changes,—these are corrected by simple manipulation; flat feet with initial changes in the skeleton of the foot,—these are treated by manipulation and subsequent transplantation of the peroneus longus tendon and, sometimes, in the presence of Morton's or Köller's syndrome, the author uses Vreden's operation, which is a transplantation of the extensor hallucis longus behind the head of the third metatarsal; the third group includes flat feet with very marked bony changes. The author recurs to his own procedure to correct these. Through a curved incision in front of the internal malleolus, an internal wedge is taken out from behind Chopart's articulation. The wedge is one centimeter wide, with its sharp edge ending at the external aspect of the calcaneus and involving the entire height of the foot. The osteotomized anterior and posterior fragments are then set in cavo-

varus, and the periosteum sutured in place; then a loop shortening of the tibialis anterior and posterior tendons is performed, the loop being sutured to the head of the as tragalus behind the line of osteotomy; a transplantation of the peroneus longus may sometimes be required to complete the operation.

The advantages of this operation are conservation of the elastic Chopart's articulation, and correction of the anterior and inferior deformity of the foot. A few good results are reported.—*Emanuel Kaplan, M.D., New York, N.Y.*

Echinococcus Involvement of the Bones. C. K. Hsieh. *Radiology*, XIV, 562, June 1930.

Echinococcus disease of bone is rare, there being 118 cases reported in the literature. Very little has been published on the radiographic findings in this condition.

The author reports one case, a Chinese male, aged forty-eight years, who had developed painless swelling in the thigh, lumbar region, and knee, which discharged thick pus for a number of months. Crepitation was felt at the crest of the ilium and at the trochanter. Tissue obtained by biopsy contained structures suggesting collapsed cysts, and a diagnosis of echinococcus disease was made. X-ray showed the right side of the pelvis and right femur extensively destroyed, leaving a lace-like hollow framework. The bones were not expanded, but the cortex was thinned out and perforated in many places. There were multiple pathologic fractures. No other bones were involved. The x-ray findings were puzzling until the diagnosis was established by biopsy. Infection was excluded because of the extensive bone destruction, lack of constitutional reaction, and the freedom from involvement of the hip joint. Malignancy was difficult to exclude.

At autopsy the ilium, ischium, and femur were mostly necrotic, with broken fragments held together by soft tissue. There were numerous cavities containing many thin-walled, grayish cysts. The bone was necrotic and the myeloid tissue replaced by the laminated walls of echinococcus cysts or by granulation tissue. There were echinococcic cysts in the liver, spleen, and pleura.

Roentgenologic diagnosis of echinococcus disease of the bone is difficult because there are no characteristic roentgenologic features. In the reported cases the x-ray diagnosis has usually been wrong. In the early stage there is absorption or rarefaction of the bone, usually mistaken for osteomyelitis or tuberculosis. In the advanced stage there is extensive cystic destruction, often mistaken for osteitis fibrosa cystica, myeloma, or neoplasm. An important feature is the absence of subperiosteal thickening and bony reaction, as are the lack of expansion of the bone, the absence of pain, and the slow progress.—*Edward N. Reed, M.D., Santa Monica, Calif.*

The Treatment of Charcot Joints. E. David Weinberg. *Southern Med. J.*, XXIII, 527, June 1930.

The etiology, incidence in tabes, symptoms, and pathology are briefly discussed. The author believes there is a definite indication for operative treatment in selected cases. Those patients who do not improve under antisyphilitic and conservative treatment, and are progressively getting worse, may be given a useful joint by various operative procedures. He reports two cases where a reconstruction of the hip joint was performed; and two cases where an Albee bone graft was applied to the spine. These cases were improved, at least temporarily.—*F. G. Hodgson, M.D., Atlanta, Ga.*

Osteochondritis Dissecans. V. W. Archer and C. H. Peterson. *Southern Med. J.*, XXIII, 611, July 1930.

A brief review of the literature is given; the pathology, clinical picture, and symptoms are discussed. The authors believe the condition is more frequent than is generally thought, and that a more careful study, with this condition in mind, will reveal many more cases than are diagnosed at present. Nine cases are reported and three more questionable cases added. They suggest that osteochondritis dissecans may be one phase of the deforming non-infectious disease of adolescence of which Legg-Perthes' disease, Köhler's disease, etc., are examples.—*F. G. Hodgson, M.D., Atlanta, Ga.*

SENILITY OF BONE AND ITS RELATION TO BONE REPAIR. H. E. Radasch. *Surg. Gynec. Obstet.*, LI, 42, July 1930.

It is known that in certain elderly patients a bone may be broken without extreme violence. It is also known that repair may be normal or very faulty in the fractures of the aged.

The author seeks answers by gross and microscopic examination of bone preparations. Attention is directed to the medullary index, which represents the relation between the diameter of the bone and the diameter of the medullary cavity. With marked senile changes the cortex is thinned and the medullary cavity enlarged. The microscopic changes which appear in the weakened senile bone are described in detail. The principal change is the enlargement of the haversian canals and the formation of cavities. This change, as other senile changes, is not constant in degree of involvement in various subjects.—*Hugh Jones, M.D., Los Angeles, Calif.*

CHONDROMATOSIS OF THE JOINT CAPSULE. St. Kartal. *Surg. Gynec. Obstet.*, LI, 99, July 1930.

The author reviews the literature briefly, and speaks of two main etiologic theories, —the tumor theory, and the theory of origin on a metaplastic basis as a result of chronic irritation. As there was no pathologic material for study in the fourteen cases reported, the author does not wish to take a definite stand as to the question of etiology. However, from a study of the cases he has gained the impression that there are graded transitions between osteochondritis dissecans and arthritis deformans, and between arthritis deformans and chondromatosis.

He believes that chronic repetition of trauma is a likely agent in the etiology. He concludes that chondromatosis is probably not always caused by the same thing, and that it may be due to disturbances of development or to chronic irritation of normal cartilage islands of the synovialis. The fact that chondromatosis may be present without symptoms is stressed, and it is pointed out that with conservative treatment, or with no treatment at all, certain patients continue to do heavy labor.

He believes that treatment should be restricted to healing, with the hope that secondary arthritic changes may be prevented. Operation should be undertaken when function has been interfered with and if the joint presents a "squeezed in" appearance. —*Hugh Jones, M.D., Los Angeles, Calif.*

OSTEOCHONDRITIS OF THE GROWTH CENTERS. M. Harbin and R. Zollinger. *Surg. Gynec. Obstet.*, LI, 145, Aug. 1930.

The purpose of the paper is to review the literature, to standardize the terminology, and to report four cases of osteochondritis in one family.

According to the classification, the cases of osteochondritis are designated as primary or secondary, depending upon whether the primary or secondary centers of ossification are involved. The condition known as Legg's diseases, Legg-Calvé-Perthes' disease, etc., is termed secondary osteochondritis of the head of the femur because the femoral head is developed from a secondary rather than a primary center of ossification.

The findings in an operative case are reported. At operation the ossification center of the femoral head was found almost disintegrated in one portion and partly filled with granulation tissue. Cultures were negative.

Mention is made of secondary osteochondritis of the greater trochanter. Osgood-Schlatter's disease is classified as secondary type of osteochondritis of the proximal epiphysis of the tibia. The Sinding-Larsen or Larsen-Johannson syndrome is termed the primary type of osteochondritis of the patella. This condition occurs at about the age of six, while the involvement of the secondary centers of the patella occurs at about puberty. The changes that appear in the patella may be found in the condyles of the femur. Köhler's disease is termed primary osteochondritis of the tarsal scaphoid. It is one of the most common of the primary type. Freiberg's infraction, Köhler's metatarsophalangeal joint, etc., are examples of the secondary type involving the head of the second metatarsal bone.

Apophysitis or osteochondritis of the os calcis is the only example of the secondary osteochondritis of the cubical bones (except involvement of the accessory scaphoid in rare cases). Involvement of the humoral head in a case of birth injury, reported by Lewin, was similar to a case seen by the authors. Panner has reported a case of the secondary type involving the elbow. Vertebral osteochondritis is represented by the primary type as well as the secondary type. According to Mau the vertebral bodies have two periods of active growth: the first period of growth is retarded from the age of six until the appearance of secondary centers; the second period begins in girls at about ten years and several years later in boys, and lasts five or six years.

Calvé called attention to the occurrence of osteochondritis of the spine in the very young before the appearance of epiphyses. The early spinal deformities may be mistaken for Pott's disease or rickets. The secondary type is often found in early adolescence when an x-ray is taken of the back, because of round shoulders, and is more common than the primary type.

Case reports are reviewed in which osteochondritis of the spine occurred in three members of the same family, and the fourth member, a girl of twelve, had well defined round shoulders but negative x-rays and negative symptoms. Changes in the hip, patella, and humerus are also represented in these cases.

The etiology is unknown, but direct or indirect trauma plays a definite rôle. The occurrence of the malady in four members of one family suggests an hereditary factor.

The treatment in general consists of physiologic rest for four to six weeks. Mechanical devices should be used to prevent recurrence of deformity after plaster supports are removed. Chronic arthritis may develop in later years in the areas originally involved. —*Hugh Jones, M.D., Los Angeles, Calif.*

Congenital Dislocation of the Hip. An Operation for Defective Acetabulum. Robert Soutter. *Surg. Gynec. Obstet.*, LI, 249, Aug. 1930.

The author is concerned about those cases of congenital dislocation of the hip in which the acetabular roof is not sufficient for stability; also, about unreduced hips without stability. Mention is made of the shelf operation which has been done by various men in the past.

The main point of the article is to present the author's method of constructing a bony shelf above the femoral head. The incision extends from the anterior superior spine of the ilium to a point two centimeters below the trochanter and then backwards and upwards. A heavy graft, removed from the trochanter and adjoining neck and shaft of the femur, is placed above the femoral head and fitted into a horizontal slot cut through the outer and inner tables of the ilium. This graft is reenforced by a square cut from the outer table of the ilium above the slot and detached except along its upper edge, which is fractured but left attached, so that the square swings laterally to bridge from the side of the ilium to the heavy graft used for the shelf.

In forming a shelf for an unreduced femoral head, he stresses the importance of bringing the head down as far as possible and placing it forward to obviate the abnormal tilt in weight-bearing, and to take advantage of the increased thickness of the ilium anteriorly.

The necessity for but one incision, the rapidity with which the operation can be done, and the very strong shelf that results are pointed out as advantages of the procedure. The author has employed the operation in nine cases in a period of over three years.—*Hugh Jones, M.D., Los Angeles, Calif.*

Operative Measures in the Treatment of Affections of the Lumbosacral and Sacro-iliac Articulation. Willis C. Campbell. *Surg. Gynec. Obstet.*, LI, 381, Sept. 1930.

Sixty-three operative cases are briefly reviewed,—thirty-five of infection, eleven of trauma, three with congenital anomalies, one benign tumor, and thirteen of tuberculosis.

Campbell's fusion of the sacro-iliac joint is advantageous in that it is entirely extra-

articular. An incision is made along the posterior third of the iliac crest down to the bone. The crest and adjacent sacrum are stripped and made raw. A portion of the crest is removed and placed, together with other bone chips, into this gutter. To also fuse the lumbosacral junction, the anterior surface of the transverse process of the fifth lumbar vertebra is denuded and the graft is placed in contact with it. The lumbosacral region he fused by the method of Albee or Hibbs. The operations were done only upon the joints clinically giving symptoms. In only two instances symptoms occurred in the remaining joints after operation. There were two deaths where fusion of all three joints was attempted at one operation.

A table of the results shows:

A. Non-tuberculous cases:
   1. Of eleven sacro-iliac fusions alone, seven were excellent, two poor, and two unknown.
   2. Of thirteen cases of lumbosacral and sacro-iliac, six were excellent, one good, three poor, two died, and one unknown.
   3. Of twenty-six lumbosacral, fourteen were excellent, four good, two poor, and six unknown.

B. Tuberculous cases:
   1. Sacro-iliac, two excellent, two poor, one died.
   2. Lumbosacral, six excellent, and two died.—*J. Kulowski, M.D., Iowa City, Iowa.*

SPINA BIFIDA OCCULTA. Report of Two Cases. F. Jelsma and R. G. Spurling. *Surg. Gynec. Obstet.*, LI, 537, Oct. 1930.

The authors report two interesting cases of spina bifida occulta in which the symptoms were the usually obscure dissociated neurological findings met with in the lower extremities. In one adult woman, the history was one of ulcer formation on the great toe appearing at the age of eighteen months. She had many subsequent amputations. The diagnosis was not made until the age of twenty years. At operation a lipomatous mass, which was firmly attached to the dura by a fibrous cord, was removed. Complete recovery followed. The other case was one in which the symptoms came on insidiously at adult life, with sensory diminution followed by ulcer formation of the foot. Operation was followed by a marked improvement in the symptoms.

The best cases for operation are those showing slow progression and late appearance of symptoms.

The authors state that clinically spina bifida, spina bifida occulta, and myelodysplasia may be considered as varying degrees of the same condition. They conclude that this condition is more common than the literature would indicate. Obscure or dissociated neurological findings of the lower extremities should suggest the diagnosis.

There is a brief discussion of the incidence, classification, etiology, symptomatology, diagnosis, and treatment.—*J. Kulowski, M.D., Iowa City, Iowa.*